RADIO and ELECTRONICS

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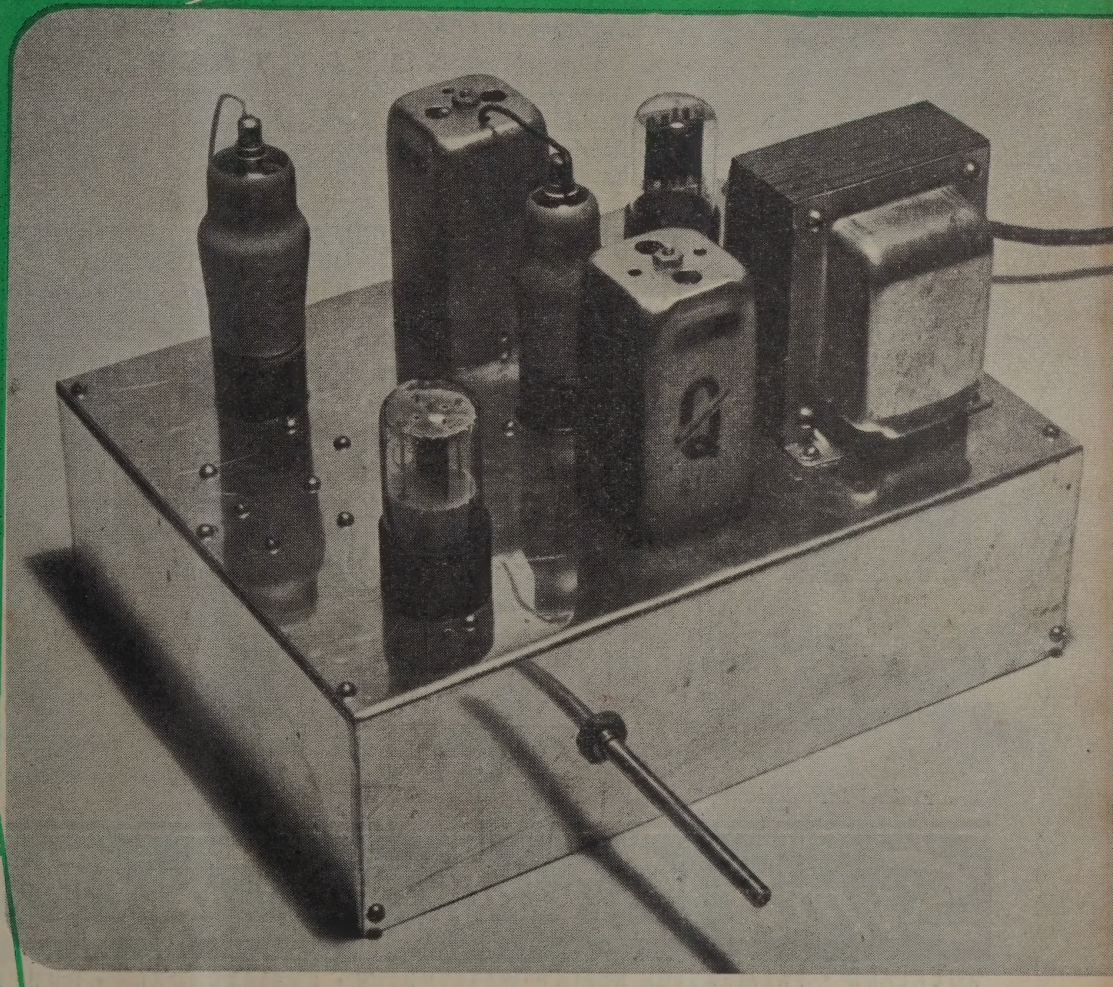

In this issue, A NEW HIGH-QUALITY TUNER CIRCUIT

JULY 1st, 1951 VOL. 6, NO. 4 1/10

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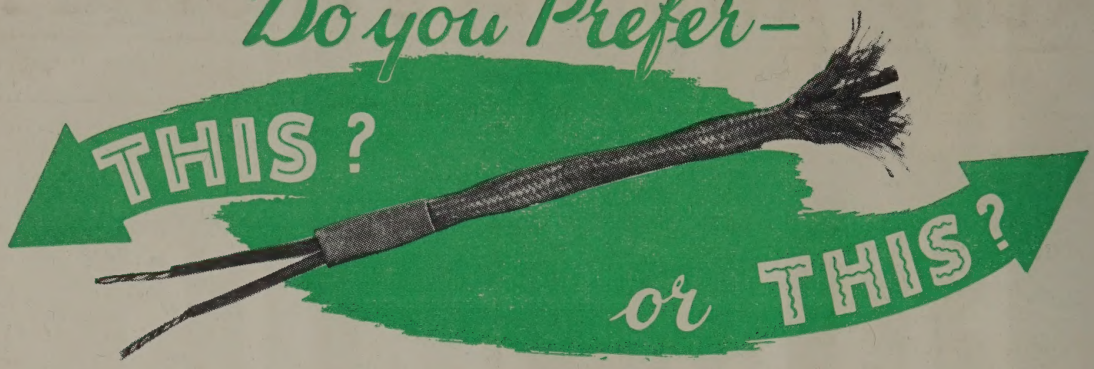

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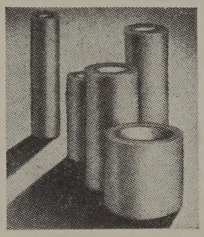

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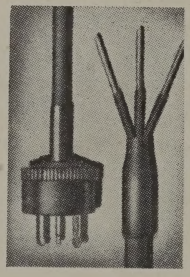

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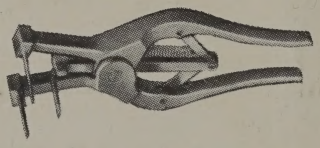

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RADIO AND ELECTRONICS

Vol. 6, No. 4 — 1st JULY 1951

	Page
Editorial	2
A New High-quality Local-station Tuner	4
The "R. & E." Amateur TV Project, Part 6	8
The *Radio and Electronics* Abstract Service	9
Letter to the Editor (TV Servicing)	11
A Summary of the Technical Advantages of the British Television Standards	13
For the Serviceman: The "Ultimate" Model RBG	14
Radio Here and There	16
Some Waveforms and How to Make Them: Part 4	18
The N.Z. Electronics Institute (Inc.) Newsletter	21
The Philips Experimenter: No. 45: An Interesting Method of Obtaining Very High Voltages	24
List of Missing or Stolen Radio Sets	31
New Products: Latest Releases in Electrical and Electronic Equipment	33
N.Z. Radio Traders' Conference: Some Snaps by Noel Souper	35
Tube Data: Midget Amplifiers 9001, 9002, 9003	37
The Editor's Opinion: The E.M.I. Component Bridge	41
Trade Winds	43
P. C. Collier Comments on the Civil Aviation V.H.F. Contract	47

OUR COVER

This month's cover features a view of the high-quality tuner the circuit of which is described in this issue. It should appeal to all those who consider quality reproduction from radio reception a necessity.

●

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Training Technicians For Television

Elsewhere in this issue readers will find an extremely interesting and illuminating letter on this topic. Mr. Slade states the problem with admirable clarity, and has some constructive suggestions to make. In particular, the idea of having different grades of technician, each with his own recognized qualifications and sphere of activity seems to us to be an excellent one. A similar arrangement, which has been in force for some years, exists in the automotive industry, and has been of the greatest benefit, not only to the employers, but to the motor mechanics themselves. There is no reason to suppose that a similar idea, applied to radio and television servicemen would not be equally as successful. As well as benefiting the trade and those who work at it, the general public would also stand to gain, just as they have done in relation to their motor-cars. Mr. Slade does not suggest how his scheme could be brought into operation, but there should not be a great deal of difficulty here. The main thing is that any scheme that might be tried, should return to the radio industry itself the right to conduct the necessary examinations, both theoretical and practical. The present situation with regard to the licensing of radio servicemen is highly unsatisfactory. The examining body is one which has no practical interest in radio at all, and which has been brought in solely as a means of ensuring that intending servicemen know how to connect power plugs without making the sets lethal weapons. An examination for servicemen which includes no practical radio examination whatever can hardly be said to ensure that the candidate is at all efficient at radio servicing! The point we wish to make is that before television is upon us, it will be necessary to straighten out the difficulties that are affecting the training of servicemen at present. And, as Mr. Slade's letter emphasizes, any changes that are made will have to be done with the object firmly in view of integrating the new scheme with any arrangement that may be under consideration for training TV personnel. When we have TV here, we will find that radio, as we know it now, and TV, will have to rely on the same people for servicing. It is not very likely that servicemen in the centres which have television will be able to ignore it, since the public will naturally go to the man who can service their TV sets, to service their oridinary radio sets too.

The establishment of a system of grading for radio service technicians seems to offer scope for the inclusion in a unified system those who are qualified to service ordinary radio sets, and those entitled to handle the various aspects of TV installation and maintenance. There would be an excellent incentive, moreover, for those in the lower grades to equip themselves technically for passing into the higher grades, and the cachet attaching to some title such as "Television Technician First Class" would do more for the public, the industry, and the trade, than could the present radio servicemen's licence.

Once a thing has got into Government control, it is a very difficult thing to get it out again, but the imminence of television seems to offer a golden opportunity for the radio industry really to do something about it. It should not be so difficult after all to prove the utter inadequacy of the present arrangement under the conditions that will soon obtain, so that the authorities will have to be made to recognize that radio servicing is not something an electrical wireman is almost automatically qualified to do.

"The Williamson Amplifier"

Since publishing a review of the collected articles on the Williamson Amplifier, as originally presented by our British contemporary *Wireless World,* we have received a number of requests from readers for copies of this book. We have pleasure in advising those interested that we have a small number of copies of the book, which came to hand recently. The price is 4s. 9d., or 4s. 10d. if required to be posted. Our original order was some time being fulfilled, owing to the prevailing shipping conditions, and when the present supply is exhausted it will be some time before further copies are available. We would suggest, therefore, that those wishing to purchase copies should send in their orders as soon as possible.

ERIE

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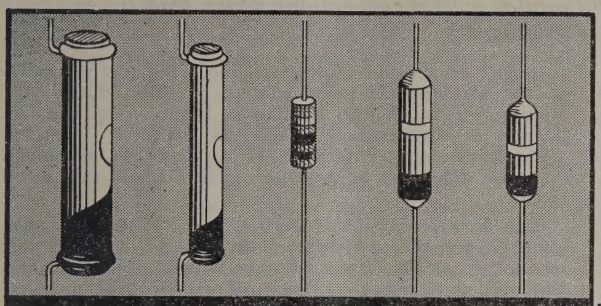

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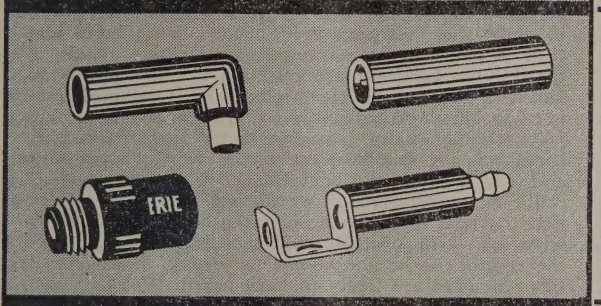

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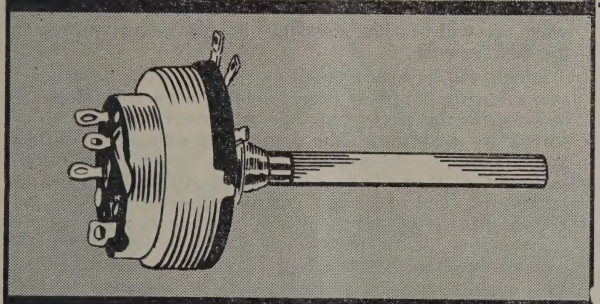

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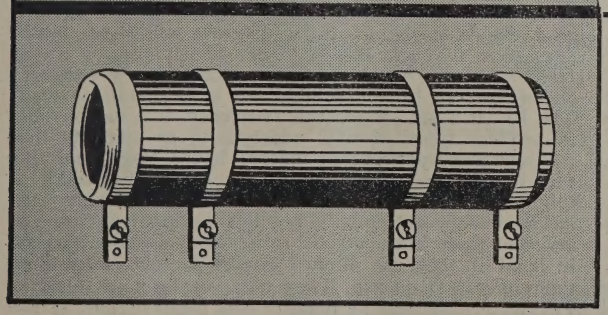

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A New High-quality Local-station Tuner

In the August, 1949 issue of "Radio and Electronics" was described a push-button tuner circuit whose purpose was to receive local broadcast transmissions with less distortion, and less side-band cutting than conventional radio sets, thus providing a high-quality output worthy of feeding into a modern amplifier and speaker system. Basically, the scheme used in that tuner was very sound, and gave excellent results. The version described here, however, incorporates several innovations which lead to even better performance.

INTRODUCTION

The problem of high-quality reception of broadcast band transmissions is one which, like the poor, is always with us. It is a fascinating topic, containing as it does scope for all the ingenuity the designer can display. It is also a problem that, so far, has not been satisfactorily solved, even by the best technical brains. A number of workable compromises exist, and tuners have been produced that approach perfection fairly closely, but it is a significant fact that broadcast engineers (who are notoriously hard to please over matters affecting quality) do not consider that a variably-tuned receiver that meets their requirements has yet been produced. One well-known engineer, who shall be nameless, but whose word on such matters is not to be lightly disregarded, even considers that a continuously tunable receiver meeting the desired specifications in regard to quality is at the moment impossible, and will remain so until some radically new reception principle is developed.

However that may be, the fact remains that all is not lost. That is to say, workable compromises are by no means outside the bounds of practicability, and more particularly if one is prepared to forego continuous tuning, and put up with pre-tuning, and selection by some form of switch. When this is done, it is possible to meet the most rigid requirements. Not with any show of simplicity, though, so the unfortunate individual quality enthusiast would still seem to be left out in the cold, unless he can build, or have built, a receiver which gains its selectivity and wide pass-band by means of a complex band-pass filter, quite a job in itself, and requiring to be duplicated for each station that is to be received.

THE NEXT BEST THING

The ideal characteristic for our hypothetical receiver is one which gives it infinite attenuation outside the required pass-band, and none at all within it. The selectivity curve then becomes a rectangle with a flat top, and vertical sides. As was implied in the last paragraph, such a response curve *can* be approached very closely if one is willing to go to the complication and expense of filter circuits instead of conventional tuned circuits. It is also possible to approach it, with only one filter, which need not be very complicated, if one uses the relatively new synchrodyne principle. The latter, however, has certain inherent disadvantages, which are not easy to overcome, so for all except experimental purposes can be ruled out. This leaves us with the seemingly age-old choice between the "straight," or T.R.F. set, and the superheterodyne. The T.R.F. is still found in the literature as the so-called answer to all high-quality difficulties, but in hard fact, it loses by several laps when it comes to making measurements, and evaluating performance properly. Briefly, its main disadvantage is that if it is made selective enough to be useful where there are more than two widely-spaced local stations, its pass-band is not wide enough. Also, it suffers from unpredictable performance on account of regeneration. This does not refer to the sort that is great enough to cause the T.R.F. amplifier to burst into oscillation, but to much smaller degrees of regeneration, which can completely ruin the performance by making the pass-band lopsided, and much narrower than can be expected from an analysis of the circuit.

This leaves only the superhet, and the present tuner uses this arrangement, in common with the earlier circuit mentioned at the head of this article. The principle employed is to use a conventional tuner, consisting of an oscillator-mixer and I.F. stage, and diode detector, but to make the intermediate frequency considerably higher than is usual in normal receivers. By this means, it is possible to effect a compromise whereby the pass-band is widened, and yet sufficient selectivity is retained outside it to enable the tuner easily to separate any local station from all the others operating in the same district. Lest some readers should question the word "compromise," and ask whether the performance is not as good as it could be made, perhaps we should state here and now, that the final design represents the best that can be done with the parts available, and that although not perfect, the results can be guaranteed to surpass those from any tuner readers are likely to have heard. We shall have a little more to say about the actual performance later, when we will be able to enlarge on just what is meant by the last sentence.

When 455 kc/sec. is used as the I.F. of a superhet, it is not a very simple matter to obtain a useful amount of increase in the pass-band. Special circuits have to be resorted to, and these are sometimes difficult to adjust, and sometimes do not quite come up to expectations. Several of them have been successfully built in our laboratory, and described in these pages, but for all-round quality of reproduction, combined with ease of construction, it is the writer's firm opinion that the scheme used here is the best of all. The use of a high I.F. enables a wide pass-band to be obtained without recourse to any of the aforementioned special circuits, as a glance at the schematic diagram will show, but it does have practical disadvantages which prevent it (*a*) from being the basis of a continuously-tuned receiver; and (*b*) from being anything but a local-station tuner. The I.F. is 2 mc/sec. At this frequency, it is not possible to produce tuned circuits which have so much Q that the selectivity approaches that of a 455 stage, and this fact is relied upon for getting the extra band-width in this tuner. Transformers designed for this frequency are not available commercially, but 1600 kc/sec. transformers are, and these are perfectly satisfactory for the purpose in hand if they are aligned on 2.0 mc/sec., instead of their official frequency. They can even be used tuned to 1.6 mc/sec. as long as none of the local stations is too close to this frequency. However, slightly less width of pass-band will be obtained if this is done, so that it is not recommended. There is no magic in the figure of 2.0 mc/sec., however. It is simply a frequency considerably

higher than 455 kc/sec., and, but for other limitations, an even higher frequency would confer still greater bandwidth on the tuner. In the first place, transformers of still higher frequency are not commercially available, until the frequency is 10.7 mc/sec., but by this time, the skirt selectivity of a single stage is not great enough to enable the tuner to separate stations satisfactorily. Also, it is considered that 2 mc/sec. is about the highest frequency that can be used, without special circuits, in the simple arrangement featured here.

WHY NOT CONTINUOUS TUNING?

It is only necessary to examine the basic set-up a little more closely to see why the arrangement is limited to pre-set tuning, and some form of selector mechanism. With the I.F. higher than the broadcast band which is to be received, there is only one place for the local oscillator —namely higher in frequency than the I.F. Now the broadcast band extends from 550 kc/sec. to, say, 1500 kc/sec. and the I.F. is 2000 kc/sec. Thus, at the low-frequency end of the broadcast band the oscillator must work at 2550 kc/sec., and at the high-frequency end, at 3500 kc/sec. If, therefore, an attempt were made to use continuous oscillator tuning, ganged with the aerial circuit, the problem would be one of making a circuit with a range of almost 3 to 1 track with one whose frequency range is only 1.37 to 1. In conventional broadcast receivers, the oscillator has a tuning range of 1.94 to 1, and even here, in spite of its commonplace nature, it is quite a problem to get satisfactory oscillator tracking. Indeed it is the relatively slight tracking error in a set with a 455 kc/sec I.F. that largely prevents this sort of set from having a satisfactory and constant bandwidth over the whole broadcast band. In the present case, the tracking difficulty would be greatly increased, and any errors in tracking would have an even more disastrous effect on the performance of the tuner. Continuous tuning, therefore, turns out to be impracticable.

There is, however, no reason why pre-set tuning should not be used, since then, each station can be individually set up, with the oscillator and aerial circuit accurately tuned, and no tracking error exists.

FOR AND AGAINST PUSH-BUTTONS

There are two ways in which station selection can be done in a set where the stations are pre-tuned. The most obvious and perhaps the most convenient way is to use a push-button unit, with one button for selecting each station. In addition, an extra push-button can be set up so that it selects the output of the pick-up or pre-amplifier, giving a "gram" button. This set-up is very convenient to use, but has certain disadvantages. First and foremost, push-button switches are not as reliable as they should be. The writer may have been unlucky, but the one he is now using at home has been in use for no more than 12 months, but is now giving a particularly annoying form of trouble. It will be necessary to take the unit out and at least give it a good clean with carbon tetrachloride, if not scrap it and install a new unit. This sort of thing does not endear the maker of the switch to the user, to say the least; certainly, by their very construction, push-button units cannot be expected to be as reliable as other forms of switch, and it is clearly desirable to guard against unreliability, unless the set is to be nothing but a source of annoyance.

If push-buttons are a source of trouble, then what sort of switch can be substituted in a circuit where the contacts must of necessity carry R.F. voltages? The only type of switch that qualifies as (*a*) capable of being used

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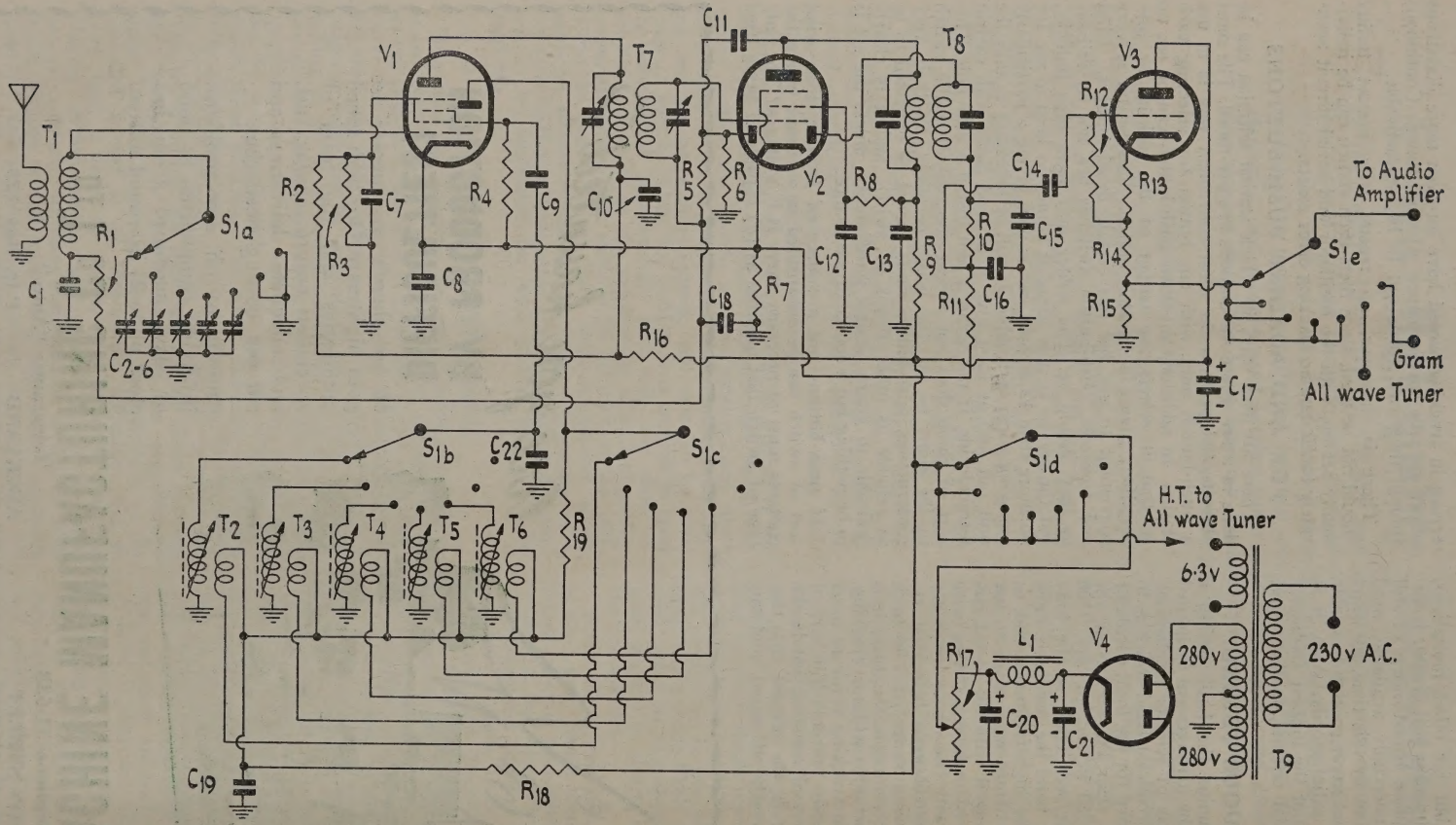

COMPONENT LIST

R_1, R_8, 100k.
R_2, 25k.
R_3, 30k.
R_4, R_{10}, R_{18}, 50k.
R_5, R_6, 1 meg.
R_7, 150 ohms.
R_9, R_{16}, 2k.
R_{11}, R_{12}, 500k.
R_{13}, 1000 ohms.
R_{14}, 10k.
R_{15}, 200 ohms.
R_{17}, 25k. voltage divider.
R_{19}, 5k.
V_1, ECH35.
V_2, EBF32.
V_3, 6J5-GT.
V_4, 6X5-GT.
C_1, C_7, C_{10}, C_{12}, C_{13}, C_{18}, 0.05 μfd.
C_2 to C_6 (inc.), Aerial tuning condensers (see text).
C_8, 0.1 μf.
C_{11}, C_{15}, C_{16}, 50 $\mu\mu$f.
C_{14}, 0.01 μf.
C_{17}, 16 μf. 450v. Electro.
C_{19}, 0.02 μf.
C_9, C_{22}, 100 $\mu\mu$f.
C_{20}, 16 μf. 450v. Electro.
C_{21}, 8 μf. 450v. Electro.
T_1, Aerial coil.
T_2 to T_6 (inc.), Osc. coils.
T_7, T_8, I.F. transformers.
T_9, Power transformer, 60 ma.
L_1, 60 ma. Power choke.
S_1 (a to e), Five-pole 7-position wafer.

in R.F. circuits, and (*b*) as reliable as can be expected, is the wafer switch, as used for wave-change switches. These can be had in up to eleven positions, which is more than can be said of push-button units, and they have the very great advantage of enabling a much more satisfactory layout of parts to be organized. With a push-button unit it is virtually impossible to make a layout that enables the rules for good R.F. arrangement to be followed. For instance, long R.F. leads are impossible to avoid, and especially where the frequencies to be handled are a little higher than usual, the push-button unit itself can cause difficulty in obtaining stable performance. With a rotary wafer switch, on the other hand, the circuit can be laid out just as well as in the case of the all-wave receiver. For example, it is possible to arrange each wafer to be quite close to the circuit with which it is concerned, because spacers of different lengths can be used between wafers. Moreover, each wafer is compact, whereas each switch in a push-button unit takes up the whole length of the unit.

In addition, the contacts of the wafer switch are much more positive in action than those of the push-button, and, in general, operate for years without any attention whatever. As against this, the rotary type of switch is not quite so convenient to use, since to get to one station the switch may have to be turned through several positions. However, for the advantages obtained, this is a very small price to pay. Another point on which the wafer scores is that of flexibility. There is almost no limit to the operations that can be performed when a wafer switch is used. The push-button, on the other hand has, as a rule, no more than three levels, or individual swtiches, operated by each button. Thus, for the purpose in hand, one of these is normally used up in switching the oscillator tuning, another in switching the aerial tuning, and the third in switching the audio output, so that one button can be labelled "Gram." The use of the rotary switch, as in the present tuner, has, in fact, enabled us to incorporate features that would not be possible with an ordinary three-level push-button switch.

DISTINCTIVE FEATURES

What, then, are the distinctive features that have been incorporated in this tuner? First of all, eight switch positions have been provided. This allows for six stations, and leaves two spare positions. Of these, one is used, as before, for bringing the pick-up into circuit with the amplifier, and the other is used for bringing into use a second, conventional tuner that will provide distant broadcast, and short-wave reception. This does away at one blow, as it were, of the nuisance of having to undo and do up connections in order to bring either the pick-up, or the extra tuner, into operation. Provision is made for applying to the common audio output terminal any desired fraction of the output of the pick-up, high-quality tuner, and conventional tuner, so that the same volume control, at the input to the amplifier, can be used at all times, without wide adjustments in setting when the various parts of the system are switched in. The tuner, therefore, becomes in addition, a means of integrating the amplifier, two tuners, and pick-up (and its pre-amplifier, if any) into a complete system instead of having them as a collection of individual gadgets. The switching that can be done with a push-button unit is not comprehensive enough to allow this to be done.

On the R.F. side, the rotary switch has enabled one very important improvement to be made to the original

(Continued on page 27.)

Mullard

VALVE NEWS

BETTER RESULTS FROM MINIATURE VALVES

The smaller and more strongly constructed parts used in the manufacture of MULLARD Miniature Valves make possible a rigid construction that is more impervious to the effects of shock and vibration. The size of the new MULLARD Miniatures makes it a factor in the reduction of the overall size of Radio equipment. The Manufacturer who wants his equipment to have that "MODERN" look must consider the use of MULLARD Miniatures, some of which are listed below, all using the B7G (7-pin Button) Base.

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EF92	..	VARI-MU R.F. or I.F. Pentode
EAC91	..	Diode-Triode frequency changer up to 300 Mc/s.
EB91	..	Screened Double Diode (6AL5)
EL91	..	Output Pentode (6AM5) 1.4 watts
ECC91	..	V.H.F. Double Triode (6J6)
DK91	..	VARI-MU Heptode frequency changer (1R5)
DF91	..	VARI-MU R.F. or I.F. Pentode (1T4)
DAF91	..	Single Diode Pentode (1S5)
DL92	..	Output Pentode (3S4) 0.27 watts
2D21	..	Gasfilled Tetrode 6.3 volts
90AV	..	Vacuum Photocell 45 uA/L
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The "R. & E." Amateur Television Project—Part VI

The Photo-cell and Video Amplifier Circuit

The only remaining portion of the original block diagram that has yet to be described is the circuit of the electron-multiplier photo-cell, and the video amplifier which brings its output signal up to usable proportions.

The circuit, shown herewith, uses four valves in addition to the photo-cell. First comes a 6AU6 miniature, used as a wide-band video amplifier stage, with shunt-peaking compensation, and this is followed by a 6J6, arranged as a cathode-follower type of phase inverter. These two valves are mounted on a small chassis with the photo-cell, and form a sort of head amplifier or pre-amplifier. The 6J6 acts either as a straight-forward cathode follower, or as a phase inverter, and enables the polarity of the signal to be changed without adding or subtracting an amplifier stage. This makes it possible to show a positive picture from either a positive or negative transparency. The advantage of this is that most people have a few photographic negatives about that make excellent transparencies if they are of the right density, while it is preferable to show that as a positive picture. At the same time, some will have or will have made negative slides for use as picture material, and here the phase of the signal has to be reversed if the picture is not to come out as a negative image. In the main video amplifier we have three stages. The first two are 6AC7s, while the final one is a 6V6. In some respects, all these stages follow normal video amplifier practice, but in others they do not. However, there is good reason for all the departures from standard practice, and among other things, by means of simple alterations, it should be possible to make the performance of the amplifier suitable for reaching much higher definition than the 200 to 250 lines that are being resolved in the initial equipment. It might have been possible to do the present job with fewer tubes, but had this been so, it would certainly have been at the expense of simplicity and ease of adjustment. Let us then examine the circuit in some detail.

DETAILS OF THE VIDEO CIRCUIT

The first thing of interest is the 931A multiplier photo-cell and its circuit. The cell consists of a conventional photo-cathode, which is the curved electrode in the middle of the symbol. This is the electrode on which the light is received, and which emits electrons in proportion to the amount of light that strikes it. These electrons are attracted to a second electrode called a *dynode*, which is about 75 to 100 volts positive with respect to the cathode. The electrons strike the dynode, and from it dislodge secondary electrons, greater in number than the original ones. Thus, a larger stream of electrons issues from the dynode than originally hit it, and the beam of electrons is said to have suffered electron multiplication. These electrons are now attracted by a second dynode, about 75 volts positive with respect to the first, and the multiplication process occurs again. Altogether there are nine dynodes, and after impinging on each one, the electron stream is augmented in size. All that is necessary to obtain this sort of amplification is to have the dynodes at successively higher positive potentials with respect to each other, and this is the purpose of the string of 25k. resistors, connected to a voltage of —750 or so. The last dynode is at earth potential. The fact that a negative supply is used has no effect on the operation of the system, but it makes the rest of the circuit easier to arrange. The electrons from the last dynode are collected by a plate, or anode, which is made more positive than the last dynode, and which is treated so that it does no secondary emission. The current drawn by the naode is passed through a small load resistor of 2000 ohms, and in doing so causes the signal to appear as a voltage drop across it. A coupling condenser therefore transfers this voltage, which is an alternating one, to the grid of the first amplifier tube in the normal way, and the most unusual part of the circuit is completed, except for the 500 $\mu\mu$f. condenser and 1000-ohm resistor which are in series across the 2k. load resistor. These will be discussed later under the heading of adjustments.

The 6AU6 has its cathode earthed, and is provided with battery bias, from a small 1.5v. cell. This has been done in order to avoid the use of cathode bias. It is essential in the video amplifier, not only to ensure that the high-frequency response extends out to several megacycles, but that the low response is preserved down to well below 25 c/sec. The reason for this may not be immediately apparent, for as we all know, normal audio amplifier circuits respond to frequencies as low as this quite well, and yet use conventional cathode biasing arrangements. Here, however, the requirements are rather more stringent. Not only must the response be retained, but there must be very little phase shift, and it is the latter which is the limiting factor in the performance, rather than the plain amplitude or response. We have four stages here, and if normal cathode biasing were used in all of them, the low-frequency phase response would not be nearly good enough, and would cause undesirable effects in the picture. The simplest cure is to do away with cathode bias altogether, and use batteries, which can take up very little room, and have no disadvantages in experimental gear. Note also the very heavy bypassing of the screen of the 6AU6 and the 6AC7s. Contrary to audio practice, 8 μf. electrolytic condensers are used here, and the reason is again to be found in the need for preserving the low frequency response. Since electrolytic condensers are not very effective bypasses at high frequencies, they are paralleled in all cases by 0.01 mica condensers, which look unnecessary, but are actually essential. Another point, also connected with the low frequenc yresponse, is the use of 0.25 μf. grid coupling condensers.

The coil in the plate circuit of the 6AU6 is a high-frequency peaking coil, which, when properly proportioned, extends considerably the high frequency response. In the first place, high frequency response is extended by using very low values for the plate load resistors of all the amplifier stages. This renders the input and output capacities, of the valves, which tend to bypass high frequency components to earth, much less effective, according to the well-known principle, by virtue of which capacities become less effective as bypasses the lower the resistance across which they are onnected. The coil forms a very low Q tuned ircuit, together with the stray capacities, and makes use of them to boost the higher frequencies that would have been lost otherwise. In the present case, the coil consists of a single-layer winding of 40-gauge wire, wound to a length of 7/16 in., on a half-inch diameter former.

There is a mistake on the circuit of the 6J6. The cathode resistor is specified as 500k., whereas it should

(Continued on page 46.)

THE "RADIO AND ELECTRONICS" ABSTRACT SERVICE

ANTENNAE AND TRANSMISSION LINES

Every television technician encounters the challenge of fringe area reception. To meet the needs of those situated in a canyon a Radarray antenna was used at the top of a hill and the homes were supplied from an open-wire line 490 ft. long which answered the problem.

—*Radio and Television News* (U.S.A.), April, 1951, p. 57.

The paraboloid antenna described herein for radar has the property not only of receiving the transmitted polarization, but also of receiving separately and simultaneously its cross polarized component. The special design permits transmission and reception of any specified polarization in search radars.

—*Electronics* (U.S.A.), March, 1951, p. 103.

AUDIO EQUIPMENT AND DESIGN

The main difficulty in achieving realistic reproduction in the home seems to be in making the lower bass frequencies audible with a reasonably small baffle. To dispense with a large baffle the circuit described provides for increasing the harmonic content of the lower bass frequencies by introducing harmonics from a second channel in which amplitude distortion has been allowed to occur.

—*Wireless Engineer* (Eng.), April, 1951, p. 132.

A description is given of the sound system installed in the new House of Commons. The system provides for the reinforcement of any speaker's words and an elaborate control system is provided for.

—*Ibid*, p. 9.

Magnetic recording tape with notes on the properties of low, medium, and high coercivity coatings. Reference is made to what is known as "transfer" or the duplication of a signal from one point to another, and to the ease of erasure in relation to the coercivity.

—*Ibid*, p. 149.

Further information is given in regard to an equalizer preamplifier for recordings. The circuit given incorporates a practical equalizer switching circuit, and a table is given to indicate the circuit which is most appropriate for various commercial types of records.

—*Radio and Television News* (U.S.A.), April, 1951, p. 46.

Another design is given for the home amplifier with a 20-watt wide-range amplifier and a novel control circuit to superintend the amplification of a wide range of frequencies.

—*Ibid*, p. 39.

CIRCUITS AND CIRCUIT ELEMENTS

Core saturation, which in many applications is undesirable, provides a key to the solution of a number of industrial problems. When an iron core becomes saturated the inductive reactance decreases, and the degree of saturation can be controlled by a D.C. winding which supplies the measure of control. Certain relay devices using the principle are described.

—*Radio and Television News* (U.S.A.), April, 1951, p. 42.

A transistor multiplying circuit—by utilization of the special characteristics of crystal triodes, frequency multiplication of two voltages can be obtained without valves, the principle being used for mathematical operations.

—*Electronics* (U.S.A.), March, 1951, p. 140.

ELECTRONIC DEVICES

The radio sonde has become well-known as a balloon-borne instrument for telemetering meteorological information, such as temperature, pressure, and humidity from the atmosphere to ground. The radar sonde is a mobile transponder which transmits its own signal when triggered from the ground, and a variety of useful information can be obtained.

—*Wireless World* (Eng.), April, 1951, p. 155.

The detection of tramp metals in materials in process is an important problem. Information is supplied of methods of the detection of the unwanted metal by the principle employing an alternating magnetic field.

—*Electronics* (U.S.A.), March, 1951, p. 88.

The stepless speed control of electric motors with the aid of electronic equipment is described.

—*Radio and Television News* (U.S.A.), March, 1951, p. 35.

The "Wobble Organ" is a form of musical instrument which in effect comprises audio oscillators controlled as to pitch by the players, and the control arm is "wobbled" to simulate vibrato effects. There is a field for interesting experimenting herein.

—*Radio and Hobbies* (Aust.), May, 1951, p. 19.

Notes are given of the use of television to extend the range of the ordinary microscope by virtue of the small "Vidicon" tubes. These tubes may be constructed sensitive to different parts of the spectrum, and so save staining of the specimen.

—*Radio and Hobbies* (Aust.) May, 1951, p. 23.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

The thyratron and its industrial applications—seven basic methods for the control of the firing angle and four primary sources of noise are analysed with circuit diagrams and waveforms.

—*Electronics* (U.S.A.), March, 1951, p. 106.

A summary is given of the characteristics of silicon and germanium crystal diodes with dimensions and terminal data. The list given shows a very wide variety of types now available in the U.S.

—*Ibid*, p. 112.

MATHEMATICS

Referring to the valve in the form of a voltage generator is well known, but there is also a less known current generator equivalent. The choice of methods of calculation depends on which makes the better use of the data, and the equivalents themselves are basically the same.

—*Wireless World* (Eng.), April, 1951, p. 152.

INSTRUMENTS AND TEST GEAR

Frequency measurement in the ham shack has become a vital necessity. Construction details are given of the "band-edger" which is an easily made test unit which is a combination of a crystal oscillator and a multivibrator.

—*Radio and Television News* (U.S.A.), April, 1951, p. 48.

Construction details of a compact, tubeless test unit for checking audio distortion. It is easy to build and ideal for those who have an audio oscillator and 'scope. The instrument works on the "subtraction" principle of eliminating the fundamental frequency by a selective device and measuring the magnitude of everything that is left, and which comprises the hum, noise, and distortion signals which are coming from the amplifier.

—*Ibid*, March, 1951, p. 46.

At some time every experimenter discovers the usefulness of a variable test resistor for trial and error methods. The calculation of the desired resistance for the job is made easier by a calibrated resistor which has a dial that reads directly in ohms.

—*Ibid*, p. 50.

Increasing the bandwidth of the older oscilloscopes. Many small screened 'scopes can be given new life by the addition of a simple easily-built circuit here described.

—*Ibid*, p. 104.

A simple explanation is given of audio frequency distortion measurements and the instruments used for that purpose.

—*Radio and Hobbies* (Aust.) May, 1951, p. 49.

An electronic fluxmeter is described actuated by means of a coil connected to a device capable of integrating the voltage produced in respect of time. A circuit of the instrument is given, and a means of calibrating by condenser discharge.

—*Wireless World* (Eng.), April, 1951, p. 161.

RECEIVERS

A converter is explained which is especially adapted to use on car radios and covers 10, 20, and 80 metre bands.

—*Radio and Television News* (U.S.A.), March, 1951, p. 48.

Here is a very interesting little design for the amateur of a super-regenerative set for the broadcast band which can be installed in not much larger than a cigarette case. The circuit is novel and appears simple to adjust. Only one miniature valve is used.

—*Ibid*, p. 43.

Hints on servicing A.C.-D.C. sets. A test prod connected to ground through a 6-watt, 110-volt lamp and a neon lamp will prove to be a real time-saver when servicing receivers of this type. The test procedure in tabulated form is given as well as the circuit of the device.

—*Radio and Television News* (U.S.A.), April, 1951, p. 60.

TELEVISION

Deflection modulation, *i.e.*, picture information supplied by changes in the horizontal scanning velocity, was an early device in television. The old form, although having no place in modern television broadcasting, may still have useful industrial and military uses, and is well worthy of study.

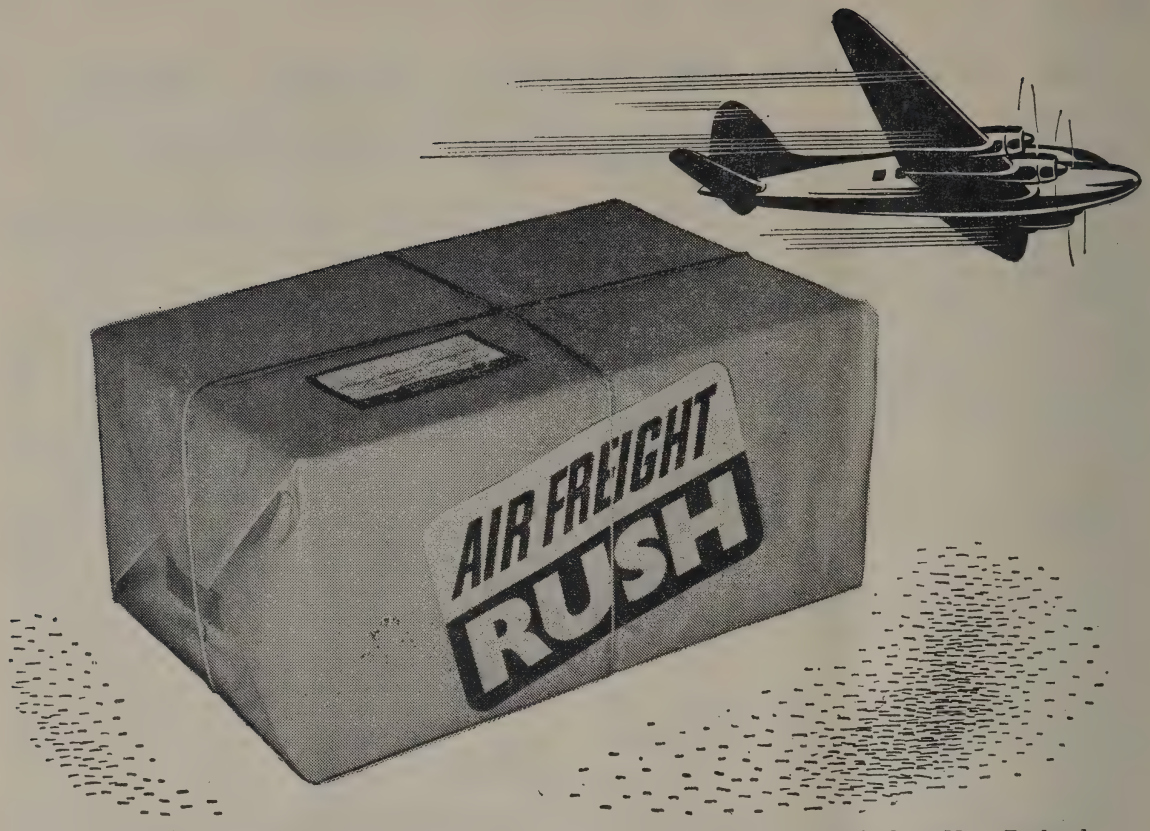
—*Ibid*, p. 36.

Although "horizontal pulling" with its most objectional distortion is a common trouble in television receivers, there is now practically no information on the subject. These articles are designed to meet the need for authoritative data.

—*Ibid*, March, 1951, p. 61, and April, 1951, p. 50.

The main disadvantage of permanent-magnet focusing devices in stray fields that spread into the ion trap and deflection yoke regions. The success of p.m. focus units depends on the mechanical design and construction, and pole pieces must be operated below saturation.

—*Electronics* (U.S.A.), March, 1951, p. 95.



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LETTER TO THE EDITOR

SERVICING AND TECHNICIANS FOR TV

Sir,—"This Television Business," by arrangement with the Walrus, in your June issue, ends up with a stimulating thought for the future TV serviceman.

A similar thought has stimulated me into sending you the following results of a little research into the likely consequences of TV servicing in New Zealand and the responsibility resting on the shoulders of the executives of this growing industry of ours.

TV servicing requires three things:—
Adequate technical data;
Spares;
Knowledge and experience.

The manufacturer can and will supply the first two but what of the third?

A television set is a highly intricate electronic device which uses a pulse technique which is unknown territory to the radio service technician, so that even a highly skilled radio serviceman has to learn a great deal before he will be of value for TV servicing.

Unfortunately, a low birth rate fifteen years ago, and a six-year war, which interrupted training routines, have combined to produce today's great scarcity of skilled and adequately trained radio technicians.

There are, therefore, fewer men than normal from whom to select our future TV servicing personnel.

To say that this is serious is a gross understatement and this is why:

A careful check has been made recently of all authoritative statements on the economics of the TV industry in both U.S.A. and U.K.

I find, for instance, that the American public is spending somewhere between 10 per cent. and 15 per cent. of their national TV expenditure on installation and maintenance.

Most of this expenditure represents labour—skilled labour.

I find also that an analysis of TV service calls in well-established TV areas shows that the *minimum* number of service calls per TV set per year must at present be set down as five and that seven to eight calls appears to be a fair average.

This means that for each 100 TV sets in the field, about three calls a working day can be expected, and if we assume, based on experience, that a TV serviceman could average six calls per day, one serviceman is needed for every 200 sets.

Besides this, skilled installation requires a team of two men who can install about three TV sets per day (difficult cases excluded) and therefore such a crew could not install more than about 1000 sets in a year.

So, even in countries where TV is already established and where skilled installers and servicemen already have a background of experience, it means that an increase of 10,000 TV sets in one year requires an additional 20 installers and an additional 50 servicemen at the end of the year.

Even if we assume that sufficient installation crews were available, it still means that somehow or other the TV industry in New Zealand has to deliver into the servicing field fifty trained servicemen for every 10,000 sets sold.

At present, we are only a radio industry and possibly TV is still five years off, *but it takes at least five years to adequately train a suitable and intelligent lad to become even a skilled radiotrician.*

And what are we doing about it?

Perhaps some of us haven't yet given the matter much thought so let us start now.

Fortunately, not all the aforementioned seven or eight calls per set per year are real service calls. They can be divided into three groups:

Nuisance calls caused by ignorance of the owner or by bad transmissions.

Calls caused by defective aerials—weather damage, etc.

Defects in the sets.

Aerial defects are infrequent and are not a serious difficulty so that the calls can be divided substantially into five to six nuisance and two real calls per set per year.

We can therefore conclude from this that we need three kinds of TV technicians.

(*a*) For installation.
(*b*) TV technicians second-class.
(*c*) TV technicians first-class.

The installation people need not be qualified technically, so long as they have a moderate amount of theoretical training and can adjust a set to a test pattern.

They must be willing and able to climb roofs and erect antennas, etc.

The second-class TV technician needs to look after the high proportion of nuisance calls and the more simple real calls. This group needs a fair theoretical knowledge and must be able to give good demonstrations with different models and have sufficient practical knowledge to determine what is at fault—the customer, the programme, the antenna or the set, and if the set, to trace and exchange faulty tubes, to readjust picture tubes, etc.

They should also have some understanding of the psychology of the customer and have a certain amount of selling ability.

The ideal would be that these second-class technicians are our first-class technicians to be.

The first-class technicians must be able to locate and repair *any* fault and at the same time be willing to use their skill, knowledge, and experience in training their juniors. As a group they are really the backbone and technical executives of any TV servicing organization.

The training of the installation crews presents no problem and in any case it is not difficult to imagine that some firms will specialize on this type of work.

The second-class TV technician would appear to be the present-day average radio serviceman (meaning no disrespect to him, of course) who has assimilated the necessary minimum of TV knowledge.

The first-class TV man is likely to come from the ranks of the larger selling or manufacturing organizations or eventually from our universities or technical colleges or wherever there is scope for specialized training and experience.

In the beginning the unfortunate result of unpreparedness in New Zealand will more than likely reflect an initial heavy load of service work directly upon our trained factory personnel and this is a somewhat bitter prospect in my opinion.

To sum up, it seems fair and reasonable to estimate that we must create in New Zealand 10 trained installation crews about 42 or 43 second-class TV technicians and seven or eight really first-class men for every 10,000 sets that we, as manufacturers, make available for distribution.

The problem is how to train these people when there is no TV service—even experimental—on which the

trainees can gain the practical experience so essential to their future efficiency.

At present it seems fairly obvious that the initial burden will fall on the manufacturers and that they will be forced to send a small nucleus of suitable already radio skilled trainees to overseas countries for at least six months (preferably twelve).

Having gained the essential TV practical experience, they will return to New Zealand (we hope) and will commence training in the individual factories, with what equipment is found to be necessary, all the radio servicemen available so that when the TV service starts there will be at least some highly trained men and a reasonable number of second-class TV men with not less than 100 hours concentrated TV schooling who will form the backbone of the coming television service organization.

Even then, it is estimated that it would be at least a year, possibly two, before this initial group could reach the standard of efficiency required of the "first-class' group.

In the meantime, they in their turn will be training others to take their place as the "second-class" group.

I do not think that our technical schools can help very much in the early stages of TV in New Zealand. Their function is more to provide fundamental training in first principles to younger men who contemplate entering the electronic field or who are already apprentices in industry.

Their activity is, therefore, effective only on a long-term basis and for that reason I believe that those responsible for the training syllabus in technical high schools should even now be considering the introduction of TV elements.

Once again, everything indicates that the manufacturer has to provide the TV training facilities for those men who are already well equipped to tackle radio and that they may have to do so not only for their own technical staff, but also on behalf of any dealer who is prepared to send his best man to a factory for maybe some months of special training.

It is hoped that the above thoughts may stimulate constructive comment from your readers.

Yours faithfully,

RALPH SLADE.

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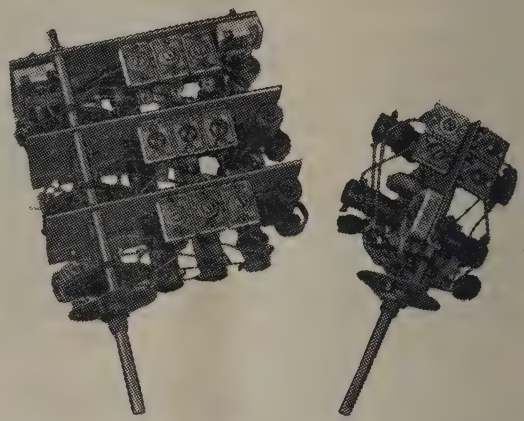

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A Summary of the Technical Advantages of the British Television Standards

By B. J. EDWARDS, Pye Limited, Cambridge, England

(Note: The views expressed in Mr. Edwards's article do not necessarily apply to New Zealand conditions, nor do they necessarily represent the views of this journal. The article is presented, however, because of its topical interest, and because of the light it throws on the many factors (by no means all obvious ones) that influence the choice of transmitting standards.—Editor.)

When in 1936 the present British television standards were adopted for broadcasting, careful consideration was given to all the possible alternatives in the light of existing knowledge and experience. In succeeding years both the French and German broadcasting authorities considered the same problem in relation to their own particular requirements and arrived at substantially the same answer. It is considered that the arguments which lead to these decisions at that time are, in the main, still valid today and that the new factors in the present situation serve to reinforce these arguments rather than modify them.

The major technical considerations affecting each of the primary system characteristics are summarized below.

1. FRAME SCAN FREQUENCY

Where the power supply frequency is 50 cycles the economy effected in receiver design by choice of a frame frequency equal to a sub-multiple of this figure greatly outweighs any advantage in flicker which may be obtained by use of a higher frequency. With positive modulation there is no advantage in a separately stabilized frame frequency and the further economy in receiver design and improved system performance to be obtained by mains synchronization are of overriding importance.

2. INTERLACING INDEX

The use of a single, in preference to a multiple, interlace or sequential scan is sufficiently generally accepted to render further discussion of this point unnecessary.

3. NUMBER OF LINES

It is considered that the optimum bandwidth is about 3 mc/sec. for the following reasons:

1. In order to provide a reasonable fraction of the population of Europe with television services it will be necessary to accommodate at least four channels in the lower frequency band.

2. The useful service area of a television transmitter falls rapidly with increasing bandwidth for the following reasons—

(*a*) The signal-to-noise ratio of the receiver deteriorates.

(*b*) The maximum transmitter power attainable falls with increasing bandwidth.

(*c*) It is difficult and costly to provide high-gain aerials with bandwidth greater than about 3 mc/sec.

3. The quality of the signal available within the service area deteriorates with increasing bandwidth for the following reasons—

(*a*) The picture is more susceptible to multipath interference.

(*b*) Impulsive noise increases linearly with bandwidth.

4. In considering population coverage of television transmitters a weighting factor should be introduced to represent the increased value of television services in remote areas where other entertainment and cultural facilities are not available. This circumstance limits the usefulness of television bands in the V.H.F. region, and emphasizes the importance of maximum possible service area for stations in the lower frequency band.

5. The cost of wide band cable links for connection of television stations and for outside broadcast rises steeply for bandwidths greater than about 3 mc/sec., and to a lesser extent the same conditions apply to radio links. The use of ordinary telephone pairs with suitable equalization is feasible for short runs up to a frequency of about 2.5 mc/sec., and can give adequate results with a system based on 3 mc/sec bandwidth. This practice would, however, be precluded with a television system based on a bandwidth greater than about 3 mc/sec.

6. At a viewing distance equal to 4.5 times the height of a television picture an eye of average acuity cannot discern any increase in definition beyond that provided by a video bandwidth of 2.8 mc/sec. Since the usual viewing distance ratio ranges from 5 to 10 for a 12 in. cathode ray tube there is little advantage to be gained from increase in definition beyond this point.

7. For a video bandwidth greater than about 3 mc/sec. two video amplifier valves are necessary in the receiver between the detector and cathode ray tube. This adds appreciably to receiver cost since the D.C. component cannot then be retained and a restorer circuit must be added.

For a video bandwidth of 3 mc/sec. 400 lines allows a reasonable balance between horizontal and vertical definition. An increase in the number of lines over this optimum in order to reduce the visibility of line structure is considered undesirable for the following reasons—

(*a*) The appearance of line structure can be largely removed by spot wobble or astigmatism.

(*b*) With 400 lines the bandwidth of receivers in fringe areas can, with advantage, be reduced to about 1.5 or 2 mc/sec. However, with a greater number of lines the loss in horizontal definition would be too great to make this practice feasible.

RADIO CLASSES

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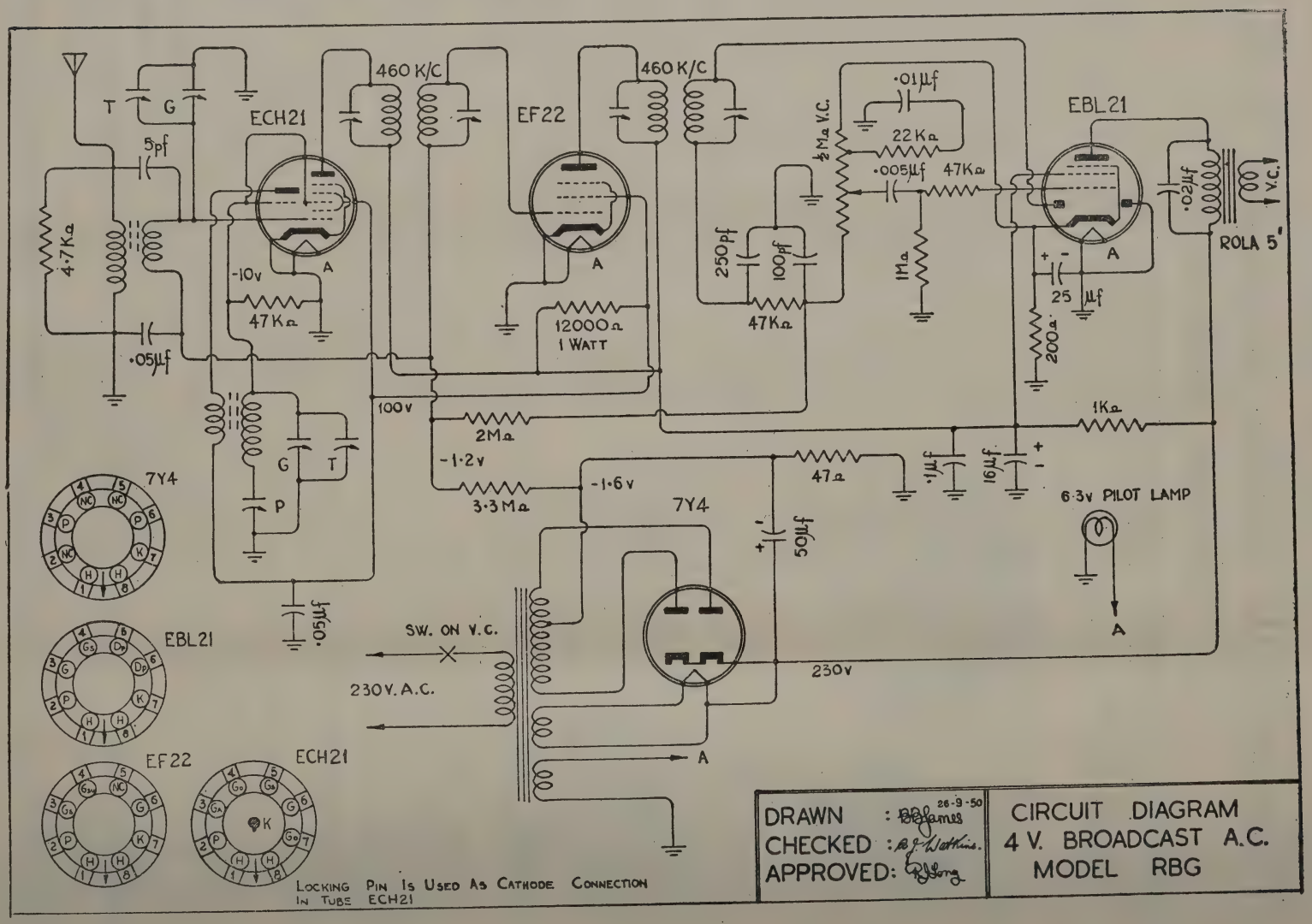


VOLTAGE APPEARING BETWEEN VALVE PINS AND CHASSIS FRAME

Valve Pin No.	1	2	3	4	5	6	7	8
ECH21	6.3vAC	220vDC	80vDC	–6vDC	80vDC	–.6vDC	–6vDC	0
EF22	0	220vDC	80vDC	0	0	–.6vDC	0	6.3vAC
EBL21	0	220vDC	0	205vDC	–1.1vDC	0	–5.4vDC	6.3vAC
7Y4	0	220vDC	180vAC	230vAC	180vAC	0	220vDC	220vDC

NOTE:' DC READINGS TAKEN WITH VACUUM TUBE VOLTMETER.

D.C. RESISTANCES

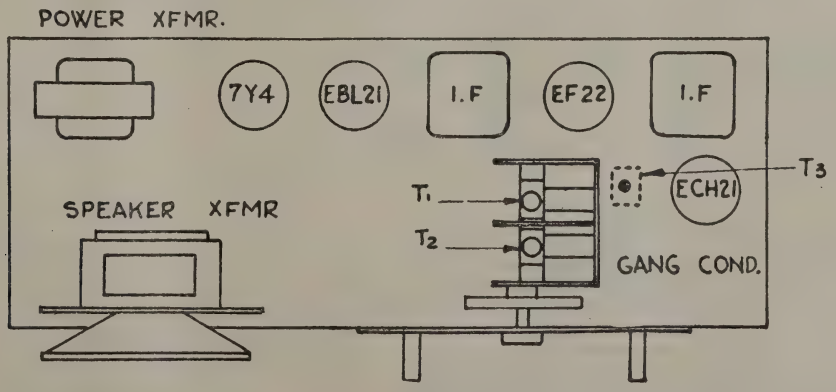
Ant. Coil Primary	22 ohms	1st I.F. Primary	9.5 ohms
„ „ Secondary	3.5 ohms	„ „ Secondary	9.5 ohms
Osc. Coil Primary	2.2 ohms	2nd I.F. Primary	9.5 ohms
„ „ Secondary	.45 ohms	„ „ Secondary	9.5 ohms
Power Xformer Primary	70 ohms	Spk. Xformer Primary	560 ohms
„ „ Secondary	203–CT–211	„ „ Secondary	.8 ohms

ALIGNMENT INFORMATION

ADJUST RECEIVER VOLUME CONTROL FOR MAXIMUM

ADJUST SIGNAL GENERATOR OUTPUT TO MINIMUM REQUIRED FOR REASONABLE OUTPUT METER READING.

Dummy Antenna	Generator Coupled to	Generator Frequency	Receiver Dial Setting	Adjust	Approx. Sensitivity for 50MW Output
.1 MFD	Grid of EF22	460 KC/S	550 KC/S	2nd I.F. Trimmers for Maximum	9000 μv
.1 MFD	Grid of ECH21	460 KC/S	550 KC/S	All I.F. Trimmers for Maximum	70 μv
RMA Standard	Ant. Lead	1400 KC/S	1400 KC/S	OSC. Trimmer T.1 for Maximum	
„	„	1400 KC/S	1400 KC/S	DET. Trimmer T.2 for Maximum	17 μv
„	„	600 KC/S	600 KC/S	Padder T.3 for Maximum	20 μv



Radio Here and There

Coloured Cored Solder Shown For First Time

Superspeed solder with a coloured resin core was shown for the first time at the annual Radio and Electronic Component Manufacturers' Federation Exhibition (Grosvenor House, W.1.) by H. J. Enthoven and Sons, Ltd. The coloured resin is in red, blue, green, or yellow and samples of soldered joints using this new product were available for inspection.

Difficulty and delay has been experienced by manufacturers in assembly and production processes because of the presence of unsoldered joints in a unit, the soldering of which is nominally complete. To guard against this risk special inspection operations are necessary, but this is difficult as the joints are often obscured by the effects of later stages of manufacture. A current method of helping the inspection to show up unsoldered joints is to coat with coloured lacquer each completed joint as it is inspected. This is not completely satisfactory, however, since the process is laborious, joint detail may be obscured, and the lacquer is rather messy and highly inflammable.

This new cored solder not only avoids the difficulties associated with the use of lacquer but it also reduces the inspection time. During the soldering process the coloured flux core is substantially dispersed to the extremities without appreciably colouring the main surface of the joint, and it can be easily examined as the essential parts are not coloured.

The colour is automatically applied during the soldering operation cutting out the laborious colouring of each separate joint. Inspection work is kept to a minimum as a visual check only is required to ensure that all joints have been made.

Another advantage of the new cored solder is that the resultant colouration is dispersed to an almost equal degree to the underside of the joint. This is particularly useful when inspection is necessary from the side opposite to where the cored solder was applied.

The addition of the colouring matter does not impair the normal efficient function of the flux at any soldering temperature, nor has the addition of the resin proved in any way adverse to the electrical behaviour of the residue, nor to the insulation resistance of the component parts to which it has been applied.

This new cored solder is identical in all respects, except colouring, to Superspeed White Flash cored solder.

Aerial Magnetic Surveys

Research on the earth's structure has been augmented by magnetic surveys from aircraft, and details have been issued on some of the preliminary flights with the airborne instruments used for this work.

For many years scientists have obtained information on the geological structure of the earth from magnetic measurements taken on the surface by means of an instrument called a magnetometer. Recent developments have made it possible to obtain much of this information with an airborne magnetometer of increased sensitivity, and this method makes a considerable saving in time and expense, and furthermore surveys can be made in areas hitherto inaccessible. Geological formations are also closely related to the magnetic survey of New Zealand, since they cause compass deviations in many areas.

With the co-operation of the R.N.Z.A.F., an aircraft has been fitted with this instrument, and an increased knowledge of the geological formation in New Zealand has already been obtained by the Magnetic Survey branch of the Geophysics Division, Department of Scientific and Industrial Research. From the preliminary flights it has been shown that ultrabasic rocks of plutonic or volcanic origin create greatest disturbance on the airborne magnetometer; acid and normal sedimentary rocks produce decreasing to no disturbance from normal. In the course of calibration flights, occasional areas of volcanic rocks beneath the Canterbury Plains have been detected.

From observations carried out at 250 land-based stations in the recent magnetic survey of New Zealand, serious compass deviations are known to exist in some areas, and it is hoped that with the airborne magnetometer precise location of these areas will be possible.

Close comparisons are possible as air- and land-based observations anywhere in New Zealand must be related to photographic traces made continuously at a base in Amberley.

A close gridwork of flights has also been made on the geothermal area, and the information obtained will be used by the scientists making investigations on geothermal-power resources.

D.F. FOILS YOUNG NEW ZEALAND STOWAWAY

Transhipment in Mid-ocean

A report received by the Marconi International Marine Communication Co., Ltd., from the radio officer of the Shaw Savill liner *Mataroa* tells how a 17-year-old stowaway's plans for a free passage were baulked with the assistance of direction-finding equipment.

The stowaway, who had boarded the *Mataroa* undetected in the bustle of passenger embarkation, was discovered the day after the vessel sailed from Auckland, New Zealand, bound for London via the Panama Canal.

Contact was made by radio with the *Delphic,* also owned by the Shaw Savill Line, which was known to be about 1,300 miles to the eastward, bound for Auckland. Radio messages between the two ships compared their respective courses and speeds, and a rendezvous was arranged.

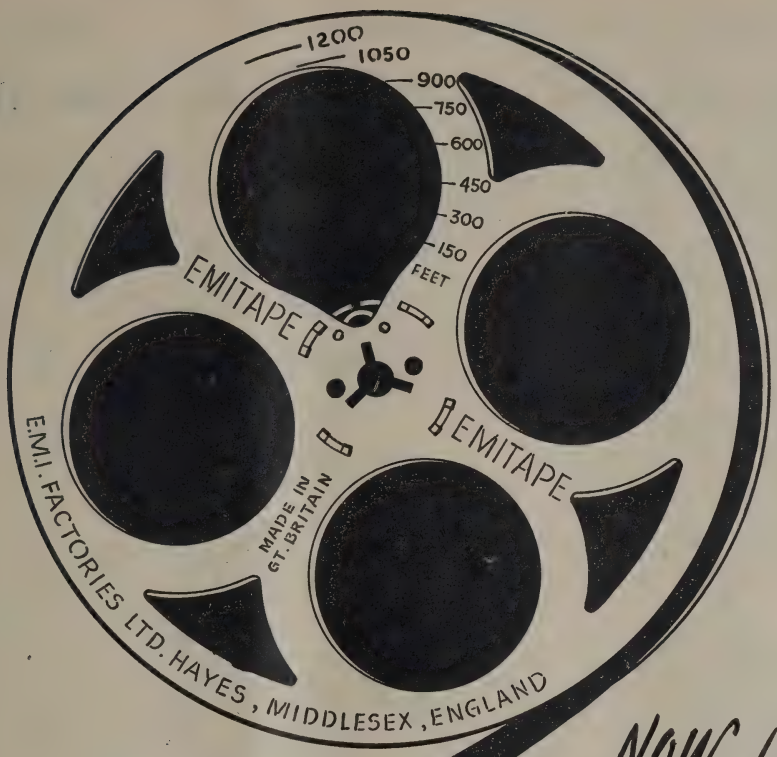
After thirty-six hours steaming, the *Mataroa's* Marconi Marine direction-finder was brought into use to take hourly radio bearings on the transmissions of the *Delphic,* and in due course those on the *Mataroa's* bridge sighted the *Delphic* dead ahead.

Both vessels hove-to at a distance of about two miles and the stowaway was transferred to the *Delphic* in mid-ocean in the *Mataroa's* motor lifeboat. Two days later the *Delphic* arrived in Auckland and a disappointed stowaway was back where he started.

MARINE RADAR UNIT USES FEWER VALVES

From users of radar for navigational purposes there has been a demand for a more than usually robust and compact ship-borne radar equipment having lower initial and improved upkeep cost. The Kelvin Hughes Marine Radar Type 2 incorporates display and transmitter units of remarkably small dimensions—particularly as a 12-in. cathode ray tube is included in the former.

(Continued on page 48.)



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Some Waveforms and How to Make Them—Part IV

In the last instalment, we saw how a square-wave with a mark-space ratio differing from unity could be produced by using a clipping circuit in which the valve is biased heavily negative, either by automatic means, or else by providing an actual negative bias by conventional methods. In the case of a negatively biased valve, the latter is cut off for most of the time, and conducts only on the most positive excursions of the grid voltage. Because of this, the waveform at the plate consists of a square-wave in which the positive portion lasts much longer than half the time of one complete cycle, while the negative portion lasts for much less than the time of the cycle.

It is possible, too, to generate a wave which is the inverse of this, namely in which the negative portion lasts much longer than the positive part. As might be expected, a simple way of doing this is to apply a positive bias to the valve, but here the question arises of

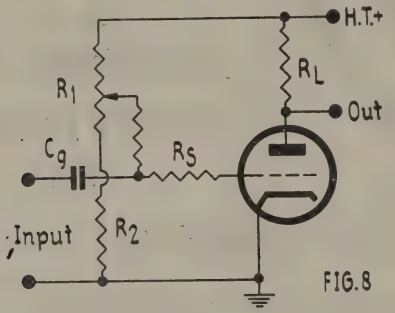

FIG. 8

whether or not this will damage the valve. The same question arose, it will be remembered, in the first circuit to be described in this series, where the grid was driven positive for approximately half the cycle. Here, the grid was prevented from going more than a small amount positive by the simple expedient of inserting a grid stopper, which acting as a voltage divider, together with the grid-cathode resistance of the tube, brings this satisfactory state of affairs about.

The circuit of a practical positively-biased squarer is shown in Fig. 8. Here, the cathode is earthed, and the grid leak is taken to a positive point, which has been shown variable in the diagram. Here again, we have a grid stopper, to limit the grid current to a safe value, and we get the same sort of clipping action. But the signal is applied to the circuit at a point which is at a relatively high positive potential, so that now, the valve passes grid current most of the time, and becomes cut off only on the negative peaks of the input voltage. Because of this, the positive half-cycles of the output waveform last much longer than the negative ones. The feature of the adjustable positive bias is sometimes very useful, because by this means, the mark-space ratio of the output wave can easily be altered without affecting the frequency (which is governed by that of the input wave) or the output voltage, which remains constant, as long as the valve is being swung between the limits of cut-off on the one hand, and grid current on the other.

POSITIVE OR NEGATIVE PORTION LONGER AT WILL

In Fig. 9 is a very useful circuit which enables the mark-space ratio to be varied between wide limits, under the control of a potentiometer. For this circuit, a separate negative bias supply is needed. The biasing arrangements determine the behaviour of the circuit, and according to the position of the potentiometer, so does the output vary between unit mark-space ratio, and the extremes of positive pulses on one end of the control, and negative ones at the other. The circuit thus acts as a combination of the three main ones that have been described in this series of articles. Let us see how it works. First of all, please note that the drawing is incorrect. The positions of the lower end of the grid leak and the cathode, on the bias chain should be the reverse of those shown. That is, the cathode should have been drawn connected to the negative end of the 25k. pot., while the cold end of the grid leak should be connected to the positive end of the

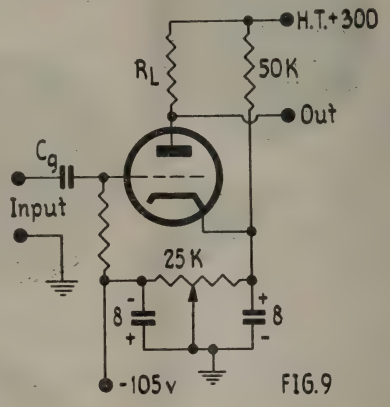

FIG.9

pot. Bearing this correction in mind, it can be seen that when the slider of the potentiometer is at the negative end of the pot., the cathode is directly earthed, and the grid is at a positive potential governed by the positive voltage divider. The bias is thus positive, and positive pulses are produced. With the slider at the positive end of the pot., the grid is at the full negative potential of 105 volts, so that negative pulses are produced. At some intermediate setting, there must be a position in which cathode and grid are at equal positive and negative potentials, so that the bias is zero, and the mark-space ratio is unity. This circuit has been used in a war-time radar set as a phasing control, for it can be seen that the position of the vertical portions of the output wave can be continuously varied with respect to the phase of the original sine-wave that is supplied as the input voltage.

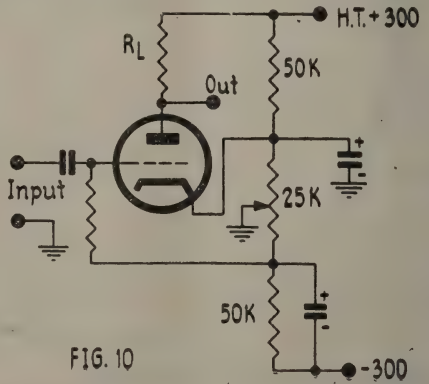

FIG. 10

ANOTHER CIRCUIT

Another circuit which does rather the same things, but which does not require a separate negative bias is shown in Fig. 10. Instead, the single power supply is "floating." Here again, the connections of the cathode and grid should be reversed, and an examination will show that the bias can again be varied from high negative to high positive values.

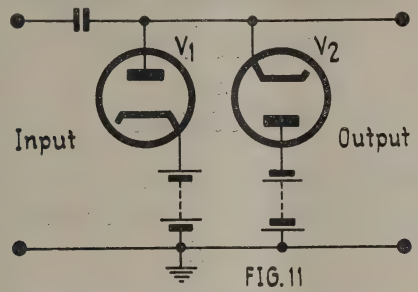

FIG. 11

USING DIODES AS CLIPPERS

Another method that is often used for "squaring up" a sine wave is shown in Fig. 11. Here we have two diodes, each biased with its own battery, connected in parallel with the input voltage. V_1 is biased negatively by the battery, whose positive terminal is connected to the cathode. Thus, if the battery is, say, 6 volts, then there is an effective 6 volts of negative bias on the plate of V_1, and it will not conduct until the input voltage makes the plate *more than six volts positive* with respect to earth. Thus, if a sine-wave of peak amplitude less than six volts is applied to the input terminal, there will be no effect on the output at all on the positive half-cycles. Now V_2 is connected the other way round, and it too is negatively biased, but on the negative half-cycles of the input. Thus, if the V_2 bias is also six volts, and the input peak voltage is less than this value, there will be no effect on the negative half-cycles either, and so for a signal of less than six volts peak, the output wave will be a replica of the input.

But when the input has a greater amplitude than six volts peak, V_1 will conduct on all that part of the positive half-cycle that is over six volts, while V_2 will conduct on all portions of the negative half-cycle that are over six volts in amplitude. As a result, the output wave will be identical with the input, except for the fact that the peaks of the positive and negative half-cycles will be chopped off, and the output will have a flat top and bottom, as with the triode clipping circuits. If the input voltage is only slightly greater in peak amplitude than the value of the bias batteries, then the sloping sides of the "square" wave will be recognizable as the parts of the sine wave that they really are, but if the input voltage is much greater, then the up and down portions will be very steep, since they will actually be only the centre-portion of the sine-wave, six volts positive and negative about the datum line. The diodes do not have to be equally biased. If only one diode is used, the resulting output will be exactly half of the sine-wave, if the remaining diode is unbiased, and whether it is the positive or negative half will depend upon which diode is removed. The clipping level in each diode can be altered at will simply be changing the value of the bias battery.

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USE OF PENTODES IN SQUARING CIRCUITS

All the triode squaring circuits we have described in this series of articles can be replaced by the equivalent pentode circuits. All that has to be done to make the change is to add the screen-grid to the circuits already given. This can be fed from a dropping resistor, in the usual way, and should be heavily bypassed with, say, a 0.25 μf. condenser. Pentodes have a distinct advantage over triodes for this purpose, in that the output wave is much more nearly square. This is because of the fact that pentodes have a much shorter grid base, and can be made to cut off at a much smaller negative voltage. Thus, not such large input voltage have to be used to get the same degree of squaring on the negative input half-cycles. Also, they give a much sharper transition at the positive end of the swing, because they do not rely on grid current for limiting the positive half-cycle at all. In the pentode, the load resistance can be made of such size that at grid voltages near zero, the operating point falls well below the "knee' of the plate curves, and over a wide range of grid voltages near zero, the plate voltage reaches a minimum, or "bottoms," as the process is called, and this limits the waveform much more effectively than does grid current in a triode. The net effect of using a pentode is that the vertical portions of the output wave are much more vertical, and indeed the same effect can be obtained with one stage, that would need two successive stages of triode squaring to attain.

As was mentioned at the outset, this series of articles in no way pretends to be exhaustive. It does show how valves are frequently used in pulse and square-wave circuits, and the diagrams given contain enough information for anyone who has an oscilloscope to perform some very interesting experiments for himself, in generating some of these waveforms.

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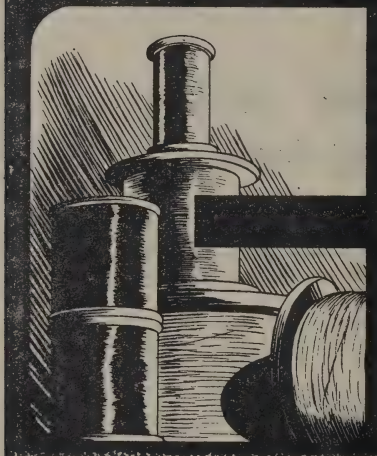

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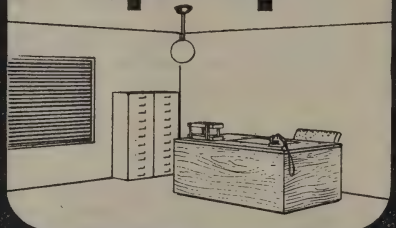

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NEWSLETTER

BRANCH NEWS

Christchurch

A meeting of the Christchurch branch was held on Monday, 30th April, 1950, at which several members were present. In opening the meeting the Chairman mentioned that the next meeting would be the branch annual meeting and as this was not expected to take very long it was hoped to give a talk on some subject, possibly television. The speaker of the evening, Mr. H. B. Fletcher, Supervising Technician of the N.Z.B.S. transmitting station at Gebbies Pass, then delivered an interesting address on "Installation of the new 10 KW Transmitters and Some of their Characteristics." Mr. Fletcher developed the complete picture of the power supplies and associated circuits by tracing through the installation and progressive testing of one of the transmitters. The large number of overload and safety devices were shown and their purpose explained. Reference was then made to the more important features of the transmitters and a complete explanation given of the operation and setting up of the dual tuning unit which permits 3ZB and 3YC to operate on the same aerial simultaneously. After a vote of thanks to the speaker, led by Mr. Hepburn, the meeting closed at 9.40 p.m.

Dunedin

The General Secretary recently paid a visit to Dunedin where contact was established with Mr. W. L. Shiel who was given copies of the new brochure which will no doubt be made available to prospective members of the institute very shortly.

Wellington

The Wellington Branch recently held its annual general meeting where the branch annual report and statement of accounts was approved and the undermentioned officers were elected: Chairman: Mr. R. J. Dippy (M); Deputy Chairman: Mr. W. D. Foster (M.); Secretary: Mr. P. Senior (A.M.); Treasurer: Mr. J. D. McCormick (A.M.); Council Members: Mr. Dippy and Mr. Foster; Management Committee: The above officers together with Messrs. R. Curry, F. R. W. Andrews, K. Salmon, and O. Rushworth.

An interesting evening was completed with a showing of appropriate films.

GENERAL NEWS

Institute Insignia

The attention of members is drawn to the crest now officially adopted as the Institute emblem and which appears at the head of this page. It is proposed to utilize this insignia on all stationery issued by the Institute in the future.

Brochures

In order to increase the membership and to give individuals some idea of the activities of the Institute there has been produced an attractive brochure which gives full information respecting activities. Distribution of the brochure has been withheld temporarily pending consideration by the Council as to the best method of tributing the pamphlets.

Institute Prize, Electrical Wiremen's Registration Board of New Zealand

The prize for the March 1951 examinations conducted by the Registration Board was gained by Mr. John Henry Weir, of Radio Corporation (N.Z.) Ltd., by whom he is employed.

A Short History of the Development of Television

Below we commence the first instalment of a very interesting booklet published by the B.B.C., and describing the present British television system. It is taken from the only copy in existence in this country, which was very kindly lent by Mr. W. L. Harrison (M.), our present President, and it is felt that members will find these articles of considerable interest.

Experimental television transmissions by the B.B.C. began in 1929 when facilities were granted to Baird Television Ltd., to transmit programmes originating in their studios in Long Acre through the London station transmitter in Oxford Street. These transmissions, which were subsequently referred to as "low-definition", employed 30 scanning lines, and 12½ pictures were transmitted per second. Vision only was transmitted, but in 1930 the transmissions were continued from the then new London Regional Station at Brookmans Park with the addition of sound. These 30-line transmissions were considered to be of sufficient technical interest for the B.B.C. to equip a studio in Broadcasting House with Baird apparatus, and this was put to use in 1932.

At this time the development of improved standards of definition was proceeding rapidly. Baird Television, Ltd., and A. C. Cossor, Ltd., were experimenting with systems using 120 lines, the latter firm concentrating on a method known as "velocity modulation." Electric and Musical Industries, Ltd., and Scophony, Ltd., also had systems which were well advanced.

APPOINTMENT OF TELEVISION COMMITTEE

The question therefore arose whether a public service of "high-definition" television was possible using very high frequencies (V.H.F.) in order to accommodate the large bandwidth necessary for the transmission of such systems. Accordingly, in May, 1934, the Postmaster-General appointed a committee under the chairmanship of Lord Selsdon to report on the relative merits of the various systems and on the conditions under which a public service might be provided.

RECOMMENDATIONS OF THE TELEVISION COMMITTEE

The main recommendations of the committee, whose report was issued in January, 1935, were:—

(*a*) That a high-definition public service should be established at an early date and that V.H.F. transmission should be used.

(*b*) That the B.B.C. should be responsible for television as for sound broadcasting.

(*c*) That a standing advisory committee, approved by the Postmaster-General, should be formed.

(*d*) That the first station should be in London and that the makers of the two selected systems, Baird and Marconi-E.M.I., should each supply their own apparatus for alternative operation.

(*e*) That the cost should be borne by the revenue obtained from the existing 10s. licence fee.

RECOMMENDATIONS OF THE ADVISORY COMMITTEE

The Advisory Committee recommended that Alexandra Palace should be the site of the London Television Station and that Baird Television Ltd., and the Marconi-E.M.I., Television Co., Ltd., should be invited to tender for the supply of apparatus for their respective systems. V.H.F. transmissions on wavelengths of approximately 6.7 metres for vision and 7.2 metres for sound were to be used, and the standards of picture transmission proposed by the two companies were accepted, namely:

(*a*) Baird System: 240 lines, 25 pictures per second, sequential scanning.

(*b*) Marconi-E.M.I. System: 405 lines, 25 pictures per second with interlaced scanning giving 50 frames per second.

A V.H.F. sound transmitter manufactured by Marconi's Wireless Telegraph Co., Ltd., was provided by the B.B.C. for use with either system.

EXPERIMENTAL HIGH-DEFINITION TRANSMISSIONS

Experimental public transmissions by both systems were radiated from Alexandra Palace during the Radio Exhibition at Olympia in August, 1936, after which the transmissions were discontinued until October when a series of trial programmes were radiated for two hours daily.

LONDON TELEVISION STATION OPENED

The Alexandra Palace Station was formally opened by the Postmaster-General on 28nd November, 1936, and a public service for two hours daily came into being on this date, the two systems being used during alternate weeks.

SINGLE STANDARD ADOPTED

On 5th February, 1937, the Postmaster-General announced that, as a result of the experience gained with transmissions from Alexandra Palace, the Television Advisory Committee recommended that a single set of standards should be adopted for transmissions from the London Station. These were as follows:

Number of lines per picture: 405 interlaced.
Number of frames per second: 50.

Ratio of synchronizing impulses to picture, 30 : 70.

Accordingly from 6th February, 1937, the Marconi-E.M.I. system alone has been used at Alexandra Palace with positive modulation of the vision signal. Both sound and vision transmissions are amplitude modulated and vertically polarized. It is interesting to recall here that the basis of this system was suggested as long ago as 1908 by A. A. Campbell-Swinton, who put forward in a letter to *Nature* an idea for the use of cathode-ray tubes at both transmitter and receiver. This idea he greatly amplified in a presidential address to the Röntgen Society in 1911 envisaging a special type of cathode-ray tube at the transmitter, which was the forerunner of the cameras in use today. The far-sightedness of this idea of forty-one years ago is remarkable, for it required only the application of modern technique to develop into the system now used by the B.B.C.

RESUMPTION AND EXPANSION OF THE SERVICE AFTER THE WAR

The Alexandra Palace television station closed down on 1st September, 1939, just before the outbreak of World War II, and reopened on 7th June, 1946, using the pre-war transmission standards.

On 1st June, 1946, a new form of receiving licence, permitting reception of television transmissions in addition to sound broadcasting, and costing £2 per annum, was instituted.

On 4th June, 1947, the B.B.C. announced that a site for a television transmitting station had been acquired at Sutton Coldfield near Birmingham, and that orders had been placed with manufacturers for the vision and sound transmitters.

At the opening of Radiolympia on 28th September, 1949, the Lord President of the Council announced that it was hoped that the construction of another television transmitting station at Holme Moss, near Huddersfield, would begin in 1950, and that it should be possible to complete this station in 1951. The Lord President also announced that, as economic conditions permitted, the television service would be extended to Scotland, to the Bristol Channel area, including populous areas of South Wales, and South-west England, and also to North-east England, Southampton, Belfast, Aberdeen, and Plymouth. The aim was to complete this programme by the end of 1954, and on its completion about 80 per cent. of the population of the United Kingdom would have a televison service.

In November, 1949, the B.B.C. announced that the Lime Grove film studios at Shepherd's Bush, London, had been acquired for the television service. The premises included five studios, ranging in size from 120 ft. x 84 ft. x 40 ft., and the production of television programmes will start there as soon as one of the studios has been equipped for the purpose. The sound and vision transmissions will continue to be radiated from Alexandra Palace. On 17th December, 1949, the station at Sutton Coldfield, using the same standards as Alexandra Palace, was brought into service.

(To be continued.)

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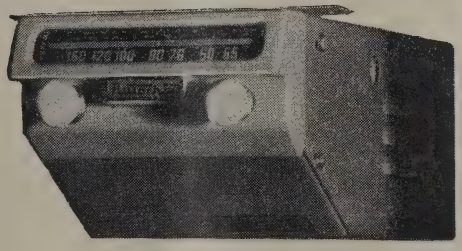

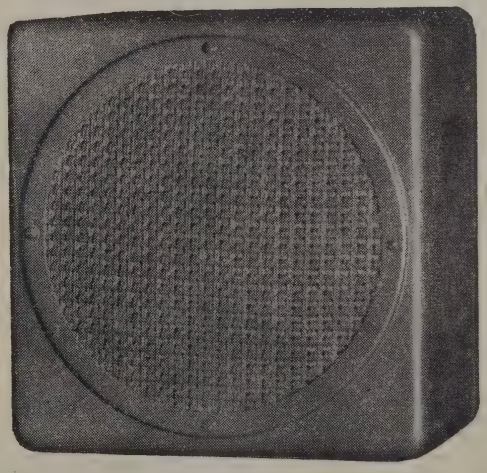

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The PHILIPS Experimenter

An Advertisement of Philips Electrical Industries of N.Z. Ltd.

No. 45: An Interesting Method of Obtaining Very High Voltages

INTRODUCTION

In these days, when cathode ray tubes and their power supplies are commonplace items of equipment, one is no longer appalled at the thought of having to provide 2000, 3000, or even 5000 volts for their anodes. Indeed, in the more advanced applications of large cathode ray tubes, it is not now a difficult matter to produce E.H.T. voltages of 25 kv. and even higher. Not many of us have occasion to use voltages as high as this, however, but some of the modern techniques by means of which these very high voltages are produced are extremely interesting, and at least one of them looks as if it might have useful applications in circuits where considerably lower voltages are required.

The method of using a special R.F. oscillator, complete with a step-up transformer, has received a good deal of publicity, and many people seem to think that it is the answer to the high voltage supply problem, especially for low-current applications such as the E.H.T. supply for C.R.T.s. Not nearly so well known, however, and every bit as deserving of publicity, is the pulse method of obtaining high voltages. This method is disguised, in television receivers, under the name of "flyback E.H.T. supply," or something of that nature, and as such is finding very wide acceptance among manufacturers of TV sets. Here, it is a by-product, as it were, of the circuit which makes the saw-tooth current wave for feeding the line deflection coils, and is undoubtedly the most economical way of obtaining the E.H.T. voltage. For other applications, however, in which no such high-frequency magnetic deflection circuit exists, it is not possible to apply the method, unless a separate saw-tooth generator is built. At first sight, this might appear a wasteful method, but where the pulse technique can be brought into use without having to produce a deflecting current waveform at the same time, it becomes very attractive indeed. It is the purpose of this Experimenter to expound the pulse method, and to describe a simple and inexpensive circuit for applying it. The circuit can be made to yield almost any output voltage up to the maximum of which it is capable, and this maximum is far in excess of that easily obtained by the R.F. method. It is also much more efficient, and draws only a few milliamps from a low-voltage power supply.

THE PULSE METHOD—WHAT IS IT?

Those who have had occasion to measure the resistance of the high-inductance primary or secondary of a good audio transformer have often had an unpleasant, but practical demonstration of the basic working of the method. This demonstration takes the form of a sharp shock, and is obtained when a small amount of D.C. passing through the coil of the inductance is suddenly interrupted. It is commonly known as the inductive kick, and is actually the back E.M.F. generated when the current through the inductance is forced to change rapidly. The back E.M.F. is actually generated whenever the current through an inductance changes at all, but has this interesting feature, that its value is directly proportional to the speed at which the current is made to change. It is also directly proportional to the size of the current that is flowing when the change occurs, and to the inductance of the winding. Clearly, the inductive kick, or back E.M.F., will be greatest for a given inductor when the speed of current change is as rapid as possible, and this condition obtains when a direct current is instantaneously broken, as by lifting a key. This is the principle on which the pulse E.H.T. system works. Obviously, although one inductive kick can have a very high voltage, not very much use can be made of it. But if we treat the inductor in such a way that it produces a rapid succession of

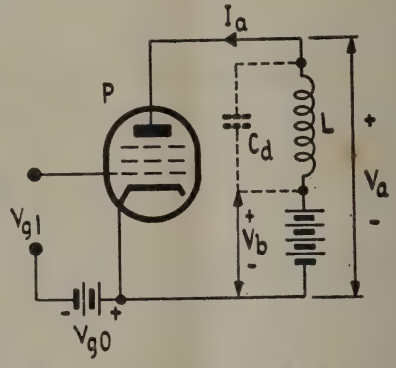


Fig. 1

inductive kicks, the output will be an alternating voltage (of anything but sine-wave shape) with an extremely high peak voltage, equal to the peak voltage of each inductive kick. Having provided ourselves with such an alternating wave, it is then a simple matter to rectify it, and produce a D.C. voltage equal (or almost so) to the voltage of each kick. Let us see then, how this scheme can be translated into practical terms.

THE BASIC PULSE-GENERATOR CIRCUIT

In Fig. 1 we have a very simple circuit, which can easily be made to produce a succession of high-voltage pulses in the manner described above. The circuit consists of a pentode, P, whose grid is biased to a voltage $-V_{g_0}$, which has a plate supply of voltage Vb, and which has a choke in series with the plate circuit. This choke has an inductance L, and, since it is a real choke, a distributed capacity Cd. Suppose for a start that the valve is passing a steady current Ia. Since this *is* steady, there will only be a D.C. voltage drop across the choke, determined solely by its D.C. resistance. This drop will be only a few volts, and so can be ignored. Now let us suppose that by means of a key, a large negative bias, sufficient to cut the valve off, is suddenly applied to the grid. The so-called inductive kick occurs, and has a peak voltage that can easily be found from the formula:

$$V = Ia\sqrt{\frac{L}{Cd}}$$

in which V is the peak voltage of the kick,

Ia is the steady current, before interruption,

L is the inductance of the choke,

and Cd is the distributed capacity of the choke, plus the plate-cathode capacity of the valve and the stray wiring capacities.

Because of the self-capacity and the various stray capacities that are connected across the choke, it is really a tuned circuit, and will tune to some frequency outside the audio range. In a typical case, the resonant frequency will be in the region of 30 kc/sec., so that the initial kick sets the circuit "ringing," and an oscilloscope connected to the plate of the valve will show a damped train of waves occurring at the resonant frequency of the circuit. This train is not damped out, because it will be remembered that we have cut the valve off, and in this condition it represents an open circuit.

Given this set-up, it is only necessary to periodically allow the valve to pass current, and then cut it off, for the kicks, and so the damped wave trains, to be repeated indefinitely. When this is done, the voltage at the plate of the valve will look something like (d) in Fig. 2. Here, Vmax. is the voltage of the initial kick, which exceeds in amplitude every other half-cycle of oscillation, since the latter is damped, and therefore dying out in an exponential fashion, as the diagram shows. If we now rectify this output wave with the conventional diode, the output voltage will be almost equal to the initial voltage, Vmax. This, then, is the practical principle employed in the pulse E.H.T. system.

VOLTAGES TO BE OBTAINED

We do not often insert formulae into the pages of the Experimenter, but in this case, we have done so, because this one shows so clearly the effects of altering the simple conditions inside the circuit. In effect, the formula says that the maximum output voltage is directly proportional to the D.C. current that is passing at the instant of interruption, and that it is also proportional to the square root of the L/C ratio of the tuned circuit. This shows why the circuit always appears, drawn as a simple choke, although the actual output waveform comes about because there is really a tuned circuit present. It is of no assistance at all to put intentional capacity across the choke, because the formula tells us that the smaller the capacity in the circuit, the larger will the output voltage be. It also tells us that the output voltage will be larger, the greater the inductance of the choke, and this is where practical considerations start to come in. It is a relatively easy matter to produce chokes with an inductance of, say, 200 henries, and it might be supposed that in practice, a choke of this nature would be used. Actually this is not the case at all. It is not possible, without a great deal of trouble and expense, to make high-inductance chokes whose distributed capacity is very low, so that it turns out much cheaper to use a choke of low inductance, which automatically has a low capacity, even though no special precautions are taken in its winding. In addition, further recourse to the formula shows that large chokes are not at all necessary. If we insert values in the formula, using volts, amps, henries, and farads as the units, we find, for example, that a choke with an inductance of 0.5 henries, and a total shunt capacity, including strays, of 50 $\mu\mu$f., will produce an output of 12,000 volts if the initial D.C. through it is 120 ma. It can be seen, therefore, that the price of using a low-inductance choke is merely the need for a relatively large current, and as will appear, this is no disadvantage at all.

PRACTICAL METHOD OF PULSING

So far we have used as an illustration, the cutting on and off of the pentode by means of a key and a blocking bias. In practice the same thing could be done by initially biasing the valve to cut-off with a battery, or a

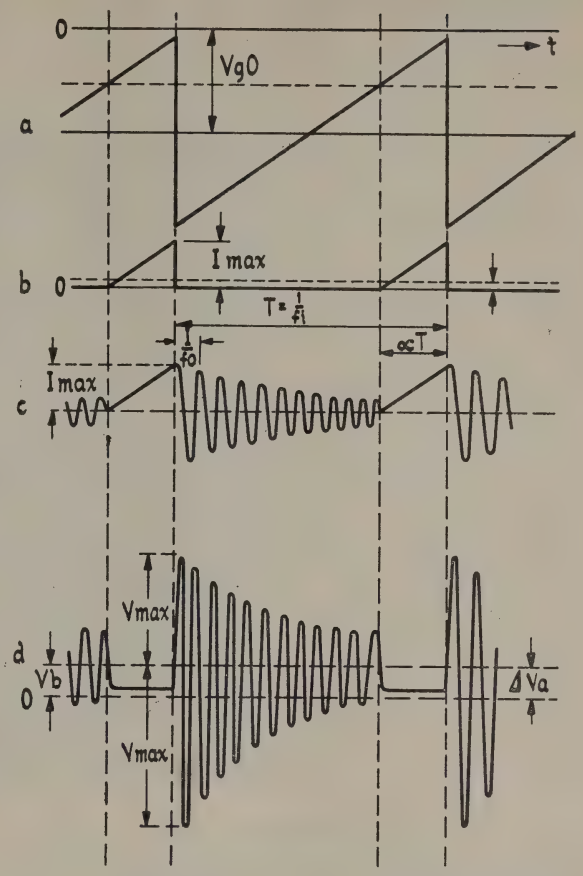


Fig. 2.—*This diagram shows, in idealized form, the wave shapes that occur in the pulse E.H.T. system, when the input to the pulsing valve is a saw-tooth, considerably lower in frequency than the resonant frequency of the choke L, and its distributed and stray capacity Cd.*

bleeder applying a fixed positive voltage to the cathode. Then a square-shaped pulse could be applied to the grid. This would first of all cause the tube to conduct very suddenly, and this would also produce an inductive kick. Its amplitude would not be high, however, and the resulting oscillation would be heavily damped by the plate resistance of the pentode, which is now drawing current. In any event, this additional kick is not wanted, because it is in the opposite direction to the one which occurs on breaking the current, and it could serve no useful purpose. For this reason we do not use a square input pulse at all, but a saw-tooth input voltage. When this is done, the action is completely illustrated by Fig. 2.

In Fig. 2 (a), the upper horizontal line represents earth potential, the dotted line, cut-off bias for the valve, and the lower line, the actual bias, beyond cut-off. The saw-tooth input voltage is applied about this voltage as its datum line, so that only the positive peaks swing into the working characteristic of the valve. The plate current increases linearly, up to a maximum which can

(Continued on page 48.)

High-quality Tuner

(Continued from page 7.)

tuner from which this one emanates. It is to use permeability tuning for the oscillator instead of capacity tuning. Previously, a single oscillator coil was provided, and pre-set tuning was done by switching in trimming condensers, in some cases paralleled with fixed condensers. This necessitates the use of compression type trimmers, if the unit is not to be too expensive to build, and previously, dual compression trimmers, as used in I.F. transformers were employed. These did not prove as satisfactory as was hoped, and a certain amount of drift in the oscillator frequency did occur. It would be possible to improve matters by using air-dielectric trimmers, such as Philips trimmers, or even midget variables, but both these solutions would prove fairly costly, without striking at the real root of the matter. It is well known that circuits tuned by fixed silvered-mica or silvered-ceramic condensers, and adjusted by means of movable iron-dust slugs are much more stable as to frequency than are circuits using small variable condensers, so that the proper way to effect a real improvement in oscillator stability is to go over to permeability tuning without further ado. Of course, this, too, is more expensive than using compression trimmers, since one coil must be provided for each station to be tuned in, but it is considered that the improvement in stability is well worth it. Here again, the rotary switch wins out, for with individual coils, it is necessary to switch both grid and plate windings. With the push-buttons, this would take up the third level, leaving no switches available for providing a gram. position.

Condenser tuning has been retained for the aerial circuit, since it is unlikely that drift will be sufficient here to affect the performance, especially if Philips trimmers are used as the variable elements—and this has been done.

OTHER POSSIBILITIES

Since there is almost no limit to the number of wafers that can be used, it is possible to include other features that may be thought desirable without being essential. For example, the necessity for providing a power supply for the high-quality tuner has enabled a reduction in cost to be made, if the whole system, with the additional tuner is envisaged. The high-quality tuner has been provided with a built-in power supply, using a 60 ma. transformer. This capacity is by no means used up in the tuner itself, whose H.T. drain is only about 30 ma., but, by adding an extra wafer on the selector switch, and providing a socket on the chassis, it has been possible to use the power supply for both tuners, switching off the H.T. from whichever one is not in use. It would be possible at the same time to bring the H.T. supply for a pick-up pre-amplifier into this same wafer, so that its H.T. is off except when it is in use.

The arrangement just described is to be found on the circuit diagram (except for the provision of H.T. for a pre-amplifier) but there are plenty of other things that could be done, simply by adding wafers to the switch. For example, it would be quite practicable to have a series of dial lamps wired to their own separate wafer so that a different one lights up to indicate the position at the moment. These lights could each be behind a small window on which is inscribed the station call-sign, "Tuner," or "Gram," thus doing away with the need for an indicator plate on the rotary switch.

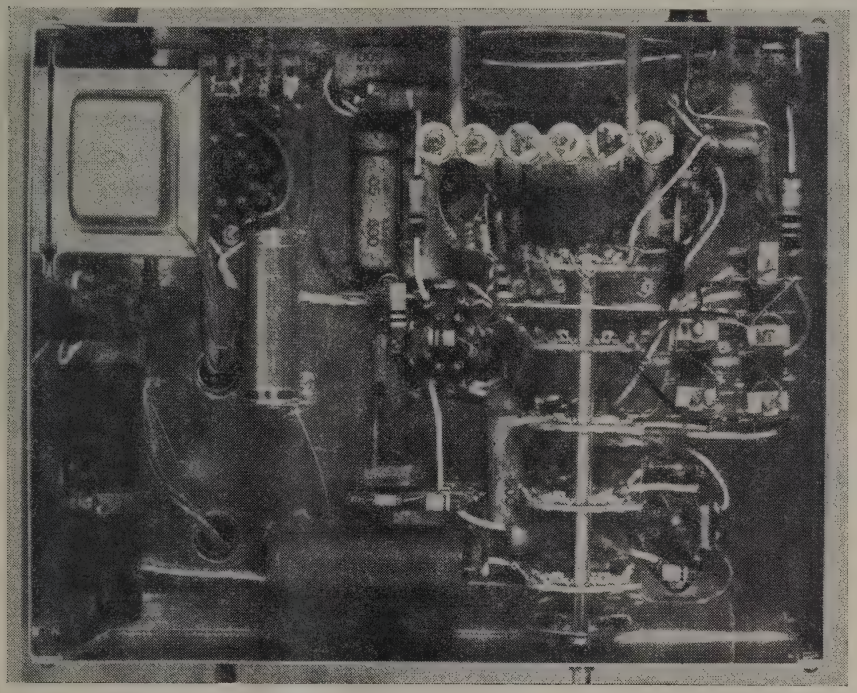
Another possibility is the addition of a further wafer for switching the mains supply to the various units, and also giving an "Off" position for the whole outfit. Readers can no doubt think of other things that could be done by adding more wafers, such as controlling the response characteristics of the pick-up pre-amplifier to suit different types of recording. This, of course, would necessitate the pre-amplifier circuit's incorporation on the same chassis, and the addition of extra switch positions as well as extra wafers. Indeed, the possibilities are almost unlimited, and the best feature is that such additional stunts can be done without in any way altering the wiring of the basic portion that is given here. The additional switching would, in most cases, be quite easy to work out.

CIRCUIT IN DETAIL

T_1 is the aerial tuning coil, which is a standard manufactured type as sold by parts dealers. This is tuned by the condensers C_2 to C_6, which are selected by the first bank of the wafer switch, S_{1a}. In the diagram it will be noted that only five station positions have been shown. On the two last positions of the switch, which bring in the additional tuner, and the gram, respectively, the grid of V_1 is earthed by the switch, in order to prevent breakthrough. The individual oscillator coils are at the bottom of the diagram, and are T_2 to T_6 inclusive. S_{1b} switches the oscillator grid winding, while S_{1c} switches the tickler windings. On the two inoperative positions, the grid is disconnected from the tuned circuits, and the plate is disconnected from H.T. It can thus be seen that the tuner is completely disabled on the two last positions, and that there is no chance at all of unwanted signals feeding through to the amplifier in these switch positions.

V_1, the oscillator-mixer, is an ECH35 in a perfectly conventional circuit arrangement, and the same can be said for the I.F.-cum-second-detector stage, which uses an EBF32. This tube gives excellent gain as an I.F. amplifier, and has the advantage of having two diodes which can be used for detection and A.V.C. rectification. This kind of tube, similar to the 6AR-GT in the Australian series of valves, gives an excellent layout in the usually congested detector portion of the circuit. It enables a very short lead to be used between the primary of the second I.F. transformer and the A.V.C. diode. This is always a point where instability trouble can arise, especially where a relatively long lead must be run between the transformer and the diode. This is because the highest I.F. voltage in the set occurs at the plate of the I.F. amplifier, and a long lead at this point radiates considerably. It is thus the most important I.F. lead of all to keep short, and the I.F. amplifier with the diode incorporated in it is the best means of ensuring this. In a set of this nature, the point we have been making is more important than usual, because the I.F. is high, and so is much more effectively radiated from any open wiring that may occur. There is nothing at all unusual about the circuit arrangement of either the detector or the A.V.C. system, both following normal practice. The detector load resistor is R_{11}, and this is returned to the cathode of V_2 so that the cathode bias voltage of this valve acts as the A.V.C. delay voltage, without affecting the detector. In this connection it will be noted that the A.V.C. diode's load resistor, R_8, is returned to earth, giving the diode a negative bias on the plate, equal to the positive cathode voltage of V_2. In the detector circuit, R_{10}, C_{14}, and C_{15} form a filter which removes the I.F. voltage from the audio load, R_{11}. The full audio output of the detector is applied to the grid of V_3, which is a cathode follower. This fulfils two most important functions, and is not an extra, but an integral part of the scheme of things. Its first, and most important feature is that its very high input im-

pedance causes practically no shunting at all on the diode load resistor, and reduces distortion in the detector circuit to negligible proportions, even at very high percentages of modulation. In a tuner that pretends to any degree of fidelity, this is essential, since a poorly designed detector circuit, diode or no, can introduce as much as 40 per cent. distortion at high percentages of modulation, thus completely ruining the performance, when it is desired to feed the output to an amplifier whose distortion is probably less than 0.5 per cent. The other important feature is, of course, the low output impedance. The load resistor of the cathode follower has been shown as split into two unequal parts. R_{14} is 10,000 ohms, and in our case, R_{15} is only 200 ohms. It is arranged that the actual output is taken from the junction of these two resistors, through S_{1e}. Thus, only about one-fiftieth of the output available at the cathode is actually used. This was because in our case the amplifier had to feed a commercial amplifier which required only 50 millivolts input to fully load it. However, any output, up to the full output of the cathode follower may be chosen, simply by varying the position of the output tap on the cathode load, keeping the total of R_{14} plus R_{15} approximately equal to 10k. The full output from the cathode is in the vicinity of 2.5 volts, so that with normal amplifiers it would be best to use the junction of R_{13} and R_{14} as the output point. S_{1e}, it will be seen, is the switch bank which determines which tuner (or the P.U.) feeds the output connecter. There will, therefore, need to be three connecters, one for bringing in to the switch the output of the extra tuner, one for bringing in the output of the pick-up or its pre-amplifier, and the third as the common output connecter, permanently connected to the input of the main amplifier. S_{1d} is concerned with feeding H.T. voltage from the power supply either to the high-qality tuner, or to the additional all-wave tuner. It could also be used to feed H.T. to the pick-up pre-amplifier, if one is used, and this would be an excellent thing to do, because it is much better to have separate H.T. supply for this unit, rather than try to provide its H.T. from the main amplifier chassis. This gives some idea of the monetary savings that can be effected by treating the combined tuners and the gramophone as a complete system, rather than as separate bits, because the one light-duty power supply contained in the present circuit diagram can serve all three of the auxiliary pieces of equipment, where if these are not integrated in this way, each might have to have its own power supply, which would be very wasteful.



An underneath view of the completed tuner. The back of the chassis is at the top in the picture. At the left are the power supply components, while the wave-change type of selector switch can be clearly seen at the right. To the right of this again are the oscillator coils, mounted in a group, while behind the switch are the Philips trimmers, in a row, which tune the single aerial coil.

The power supply is quite usual, employing a 6X5 rectifier with a single stage condenser-input filter, which is perfectly adequate, and gives a nicely hum-free output. The output voltage would be nearer 300 volts than 250 if no bleed were used, so that a 25,000 ohm voltage divider, R_{17}, is used to ensure that the tuner gets no more than 250 volts. This should on no account be omitted, as with A.V.C. acting strongly on local stations, the valves would operate with 300 volts on them most of the time if it were not incorporated. The 6.3-volt heater winding can be used as well for the additional tuner without straining the resources of the transformer at all.

SOME OF THE COMPONENTS

The first point here which might need a little elucidation concerns the aerial tuning condensers C_2 to C_6. These have been shown as variable, but for the lower frequency stations at least, they will actually consist of fixed mica or silvered mica condensers, making up the bulk of the capacity, and paralleled with Philips trimmers to give the slight range of adjustment that is necessary for accurate tuning. As a guide to what is needed, it may be stated that for 2YA, on 570 kc/sec., a total fixed capacity of 365 $\mu\mu$f. was used, while for 2YX, on

1400 kc/sec., only 15 $\mu\mu$f. was needed. The Philips trimmers have a maximum capacity of 30 $\mu\mu$f., so that in the latter case, the range of adjustment was approximately from 18 to 45 $\mu\mu$f.

It should be mentioned here that the type of aerial coil used was one designed for a gang condenser with a maximum capacity of 385 $\mu\mu$f. This has the advantage that the fixed condensers required are rather smaller than if the other type, intended for a 420 $\mu\mu$f. gang had been used.

The oscillator coils are also commercial units. They are advertised as universal replacement oscillator coils, and have iron dust slugs, combined with a copper slug, which moves with the iron one, to give a wide-range adjustment of inductance. For the present purpose, these have to be very slightly modified, but the job is a very easy one, and need not occasion any qualms on the part of the constructor. All that has to be done is to find the connecting lug to which the outside end of the grid coil is connected, unwrap the end of the wire from it, and unwind 46 turns from the grid coil. The wire is then bared and re-soldered to the original lug. The tickler remains "as is." All coils are modified in the same way, and it will then be found that with a single fixed condenser, C_{22}, arranged to tune each coil as it is brought into circuit. The whole broadcast band can be covered.

Apart from this, and the fact that the 1.6 mc/sec. transformers are tuned up to 2.0 mc/sec., there is nothing about the tuner that need cause the slightest difficulty, and builders will find the time and monetary outlay very well spent. The layout is conventional, as can be seen from the photograph on the front cover, and the underchassis view, and there should be no need to give a detailed chassis diagram.

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List of Missing or Stolen Radio Sets

As mentioned in the editorial of last month's *Radio and Electronics,* we are commencing to print fully detailed information concerning stolen and missing radios. This information is printed by courtesy of the New Zealand Radio Traders' Federation and the Police Department, and is official. The first list follows, and succeeding lists will be printed as they come to hand.

Police Station, Paeroa:

"I regret to have to inform you that on 4th May, 1951, Bond and Bond, Ltd., Paeroa, supplied the following described radio to a man who represented his name as 'D. Walker,' and gave fictitious address. Walker represented he wanted the radio for two days' trial: Skyscraper seven-valve radio-gramophone, table model, labelled 'Made by H. W. Clark, Wellington' and chassis No. 94896. Valued £58 10s. Description 'D. Walker,' European, 23 years, 5 ft. 10 in., slim build, fresh complexion, fair wavy hair, long faced, well spoken, wearing double breasted blue suit and no hat."

Police Station, Te Aroha:

"According to instructions issued to us I am forwarding particulars of two radio sets that have been stolen by means of trick from two dealers in this town on the night of Friday, 6th April last. The description of the radios are: Courier 5-valve model, white bakelite mantel cabinet, serial number 125900, valued at £19 19s. H.M.V. 5-valve, Little Nipper, brown bakelite cabinet, model 505 B.C. serial number 17984, valued at £18 18s.

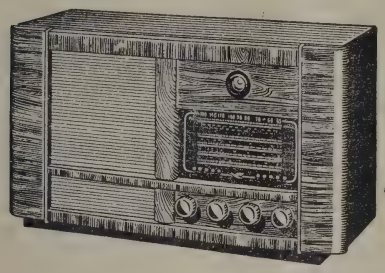
I feel that it would assist us if when you are notifying your members that the circumstances under which these radios were obtained should be mentioned as I have just been informed that the same person has secured one from Paeroa recently.

A man about 20 to 22 years of age, 5 ft. 10 in. to 5 ft. 11 in. high, thin face, fresh complexion, light brown hair, medium build, and wearing grey clothing calls into the shop when they are busy and asks for a demonstration and not getting that asks if he can take the set home for the weekend and on being granted that disappears.

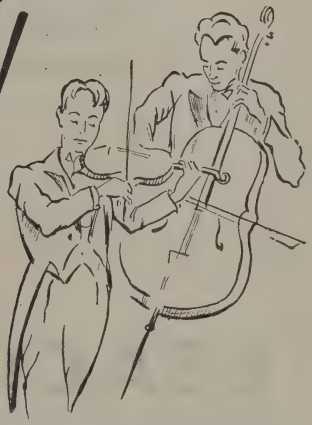
Should any of your members come in contact with such a person we would appreciate if they communicated with the nearest police immediately as at the moment we have no line on the man."

Criminal Investigation Branch, Wellington:

"I wish to advise you that the following is the description of a radio stolen from Wellington between 20th and 26th April, 1951: 'Stella' seven-valve dual-wave mantel model 514 radio, No. 17850. In the event of this radio being recovered you shall be notified accordingly."



– FOR STUDIO TONE IN YOUR HOME!

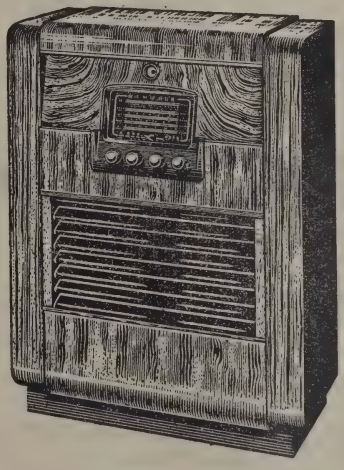


ULTIMATE 7-VALVE BANDSPREAD ALL-WAVE MANTEL

Exceptional range and rich tone. 8-inch high-fidelity speaker. Provision for gramophone and extension speaker. Attractive cabinet in highly polished selected veneers. An exceptionally fine performer.

ULTIMATE 7-VALVE BANDSPREAD ALL-WAVE CONSOLE

Here you have the last word in tone-quality, selectivity, and beautiful cabinet styling. Provision for gramophone, and extension speaker. 12-inch Rola speaker. This outstanding model challenges comparison. Let your Ultimate dealer show you why.



A wide range of Ultimate models offers a choice for every need. From 4-valve Broadcast to 10-valve Bandspread All-wave Consoles, each is in a class of its own. Your nearest Ultimate dealer will be glad to demonstrate for you.

Manufactured by

RADIO (1936) LTD. QUAY STREET - - AUCKLAND

A STOCKPILE

OF TRANSFORMERS FOR the TRADE

●

You can call on Beacon Radio, Ltd., or any of our accredited agents, for IMMEDIATE DELIVERY FROM STOCK of any type or size in transformers AT ANY TIME.

Despite difficulties being experienced now by lack of raw materials from overseas, Beacon Radio, Ltd., maintains a 100 per cent. efficient service.

Prompt delivery, too, can be given to orders to special specifications.

BEACON RADIO LTD.

BEACON RADIO LIMITED

32 FANSHAWE STREET, AUCKLAND, C.1

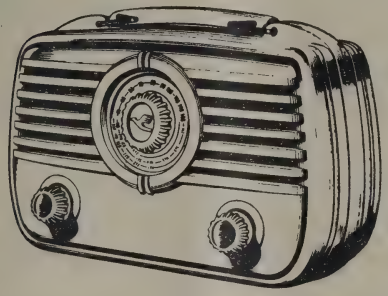
If you are not served by one of the Wholesale Distributors mentioned below, please get in touch with us direct.

WELLINGTON:	TARANAKI:	OTAGO:	CANTERBURY:
Green & Cooper, Ltd.,	J. B. MacEwan & Co., Ltd.,	R. H. Gardner,	Arnold & Wright, Ltd.
43 Lower Taranaki Street,	King Street,	42 Crawford Street,	126 Lichfield Street,
WELLINGTON	NEW PLYMOUTH	DUNEDIN	CHRISTCHURCH

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE NEW ULTIMATE PERSONAL PORTABLE RECEIVER



Illustrated here is a small robust model which works from either 230-volt A.C. or from its own self-contained batteries. The popular receiver is 9 in. long, 6 in. high, and 4 in. deep. A little larger than a lady's handbag, and weighs only 8 lb. A special power lead may be plugged into the set when it is used in the home and the flex may be detached when the personal portable is to be used out-of-doors.

The Ultimate Portable is available in ivory or walnut plastic or combination of brown and white phenolic. The Portable is equipped with a comfortable carrying handle which fits into and conforms with the smooth flowing lines of the cabinet.

The set is a 6-valve broadcast receiver and employs a No. 467 67½-volt "B" battery. No. C16 9-volt "A" battery.

A built-in aerial is provided and there is provision made at the back of the receiver for coupling to the home aerial. This popular new Ultimate receiver is available immediately.

The retail price is £26 19s. 9d. complete with batteries.

* * *

PHILIPS AUDIO FREQUENCY OSCILLATOR GM 2307, MAINS OPERATED

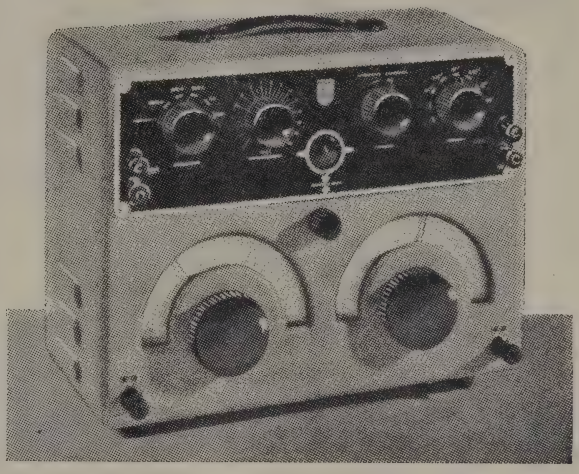
This instrument has been developed as a stable, accurate, and reliable generator of audio frequencies for use in all technical and acoustic problems.

DESCRIPTION

The audio frequency is initiated by the beat of two high frequencies produced by separate valve oscillators. The frequency adjustment is effected by means of two adjusting knobs having a scale of 30–1000 c/sec. and 30–15,000 c/sec. respectively. When both dials are used the indicated values must be added; thus the maximum frequency to be obtained is 16,000 c/sec .

The output voltage can be obtained either via adjustable steps or via the calibrated attenuator.

The output voltage normally amounts to max. 15v.; in a special position of the switch it will be 50v.; with the aid of an adjusting screw it can, moreover, be increased to 32v. and 100v. respectively. Under certain conditions the voltage can be read on the dial of the control knob



with sufficient accuracy. By means of a separate switch the output can be symmetrically balanced or not with respect to earth; in both cases the voltage is practically the same.

FREQUENCY STABILITY

Reading error: ± 1 per cent. between 200 and 16,000 c/sec.; maximum 2 c/sec. between 30 and 200 c/sec. Frequency deviation after heating up (10 minutes): < 20 c/sec. within three hours, after which there is practically no further drift.

A fluctuation of the main voltage of ± 10 per cent. causes an error of less than 2 per cent.

ATTENUATOR

Nine stages (10 db. per stage). Maximum attenuation: 10,000 : 1. Possible error: <1 per cent. of the nominal value.

OUTPUT

Normal: 225 mW., by means of a special control adjustable from 100 mW. up to 0.8 W.

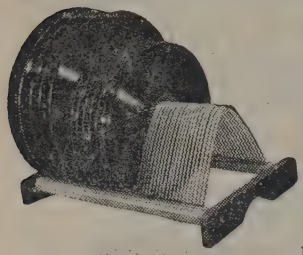
DISTORTION

Frequency	Distortion percentage at		
	100 mW.	225 mW.	0.8 mW.
30 c/sec.	<2%	<2.5%	<3.5%
100 c/sec.	<1%	<1.5%	<2 %
5000 c/sec. and more	<0.25%	<0.3%	<0.75%

DIMENSIONS AND WEIGHT

Width: 13⅛ in.
Height: 10 in.
Depth: 7⅞ in.
Weight: approximately 26.5 lb.

GRAMOPHONE RECORD-HOLDER



A very useful article which has recently reached the New Zealand market is an attractive storage rack for gramophone recordings. These are referred to under the trade name of "Platterrack" and can accommodate either 10 in. or 12 in. records. "Platterracks" are available in two sizes—to hold either 50 or 23 records and are obtainable in blue or pink flock sprayed finish with brown bakelite moulded end pieces. Where recordings are liable to be stored in dusty positions, plastic covers can be purchased at a slight extra cost. An index card is supplied with each "Platterrack" and also numbers for fixing on to records which are then placed in the appropriate position in the "Platterrack" which is already numbered. "Platterracks" will be a "must have" with all recording enthusiasts, providing neat storage and enabling any particular record to be traced at a moment's notice.

Prices are reasonable and immediate supplies are available from the sole New Zealand agents, the Grover Electrical Co., Ltd., P.O. Box 6192, Te Aro, Wellington, or any of their branches.

29 DIFFERENT RECTIFIER TUBES

Now Replaceable

with S.T.C. Miniature Radio Rectifiers

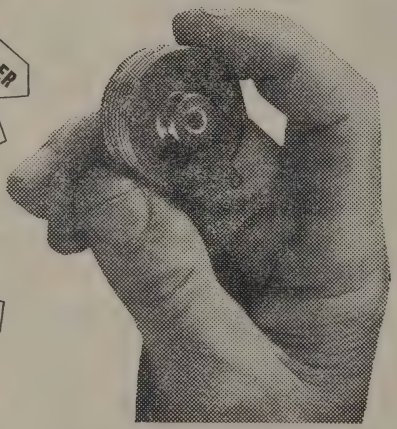
IT'S STRONGER

IT'S CHEAPER

LASTS LONGER

RUNS COOLER

SAVES SPACE

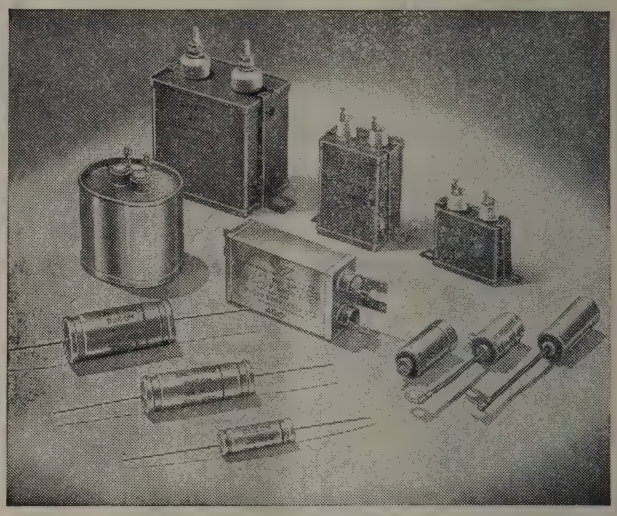


AN STC PRODUCT

Write 'phone or call the Sole N.Z. Agents

STANDARD TELEPHONES & CABLES PTY. LTD.

Wellington Box 638 Auckland Box 571
Christchurch Box 983 Wanganui Box 293



Its 'KNOW-HOW' *that does it . . .*

Ducon has the "Know-How" . . . that is why . . .

WHEN YOU SPECIFY DUCON YOU GET THE BEST.

Ducon Capacitors are functioning successfully in a large variety of applications, and in many cases under very exacting conditions.

Ducon are able to build a wide range of capacitors as a result of the extensive experience of their engineers and chemists in the capacitor field. Our world-wide affiliations with leading overseas Capacitor Manufacturers ensure that they are kept abreast of every technical advance.

DUCON *Capacitors*

Ducon (N.Z.) Ltd., Wellington

Works: 25-35 Haining Street. Telephone 54-844
Office: 21 Grey Street. Telephone 42-411
P.O. Box 630.

N.Z. Radio Traders' Conference—Chateau Tongariro, April, 1951

SOME SNAPS BY NOEL SOUPER

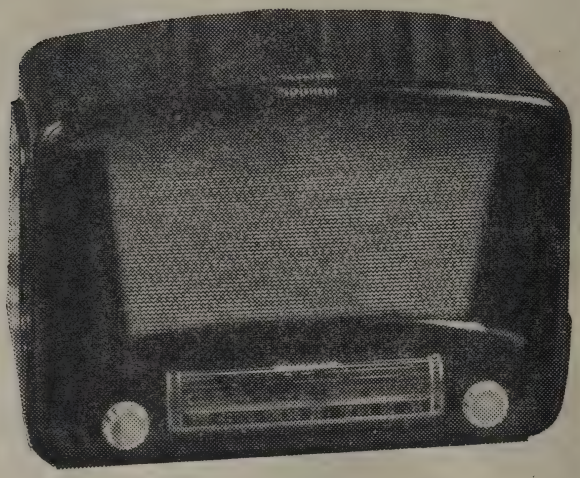
1. Peter Luxford, Mrs. Luxford, and Mrs. Souper take the view from the heights.
2. Chas. Roser wins the 18th putt.
3. Down to serious business. Shows J. Burns (back to camera), H. Osborn, P. Luxford, J. Fairclough (chairman), W. Murphy, H. Barr, J. Beachen, M. Rhodes, C. Peoples.
4. W. Murphy takes inspiration from a cigarette whilst H. Barr enjoys having made a humorous point. C. Roser (background).
5. P. Luxford and his wife relax in the sun.
6. J. Hodge and D. Chew weigh the pros and cons.
7. Bill Young in good form.
8. Matters of the moment. Left to right are H. Barr, J. Beachen, M. Rhodes, C. Peoples, S. Christie, J. Hodge, D. Chew, W. Young, J. Burns, H. Osborne, D. Foster.
9. J. Beachen all ears for Auckland.
10. Yes! It was cold!

PLASTICS IN THE RADIO INDUSTRY

SMART!

MODERN!

DURABLE!



UNIT CONSTRUCTION!

ECONOMICAL!

It's moulded from I.C.I. PLASTICS!

Plastics have many advantages over older traditional materials . . . in this radio cabinet (moulded from I.C.I. "Mouldrite" powders) for example, plastics give finer electrical insulation properties, smarter design, perfect tonal resonance from the mono-construction plus the advantages of rapid production, precision measurement for every cabinet, fixing points moulded in during construction and lowered costs.

Most moulded articles start off as moulding powders which under heat and pressure solidify—once moulding equipment is set up, production is rapid and per unit very economical. Many moulded articles are in such everyday use we forget they are plastic—for instance telephones, light-switches, door-knobs. Other moulded plastics include electric wiring, garden hose, combs, toys, hairclips, brush backs—indeed there is practically no product in which plastics, wisely used, cannot play an important part in giving better designs, in speeding production, in lowering costs.

Radio Cabinet by Philips Electrical Industries of N.Z. Ltd., Wellington.

ICI

Plastics

TUBE DATA: Midget Amplifiers 9001, 9002, 9003

The 9001, 9002, and 9003 are a series of vacuum tubes designed for ultra-high frequency receiving and oscillator applications. These tubes combine the bulb, and base structure of the miniature receiving tubes with electrode structures similar to those of the unipotential-cathode acorn tubes. Two cathode leads are employed in each of these types to permit the completion of the plate or screen R.F. circuits with a minimum of circuit inductance common to the grid circuit. The double lead feature is desirable because the effects of lead inductances increase rapidly as the operating frequency is increased. In addition, the 9002 has two plate leads. The tubes employ the convenient miniature button-type 7-pin base which requires only a small space for mounting.

Electrically, the 9001, 9002, and 9003 correspond to the 954, 955, and 956, respectively. The 9002, a triode, may be used as an oscillator in superheterodyne receivers at frequencies up to 500 megacycles. The 9003 is a super-control amplifier pentode designed for mixer and I.F. or R.F. amplifier functions. The 9001 is a sharp cut-off amplifier pentode; it may be used to advantage as an R.F. amplifier or mixer where the remote cut-off feature of the 9003 is not necessary or where only a small A.V.C. voltage is available. For such applications, the 9001 may be preferable because its low current requirements provide a somewhat improved signal-to-noise ratio.

INSTALLATION

The *base* of the 9001, 9002, and 9003 requires the use of the standard 7-pin miniature socket .The centre hole of the socket designed for the button base provides for the possibility that these tubes may be manufactured with the exhaust tube tip at the base end. For this reason, it is recommended that in equipment employing these tubes, no material be permitted to obstruct the centre hole of the socket. The sockets should make good contact with the tube pins and the dielectric should be of high quality for use at the ultra-high frequencies. These tubes may be mounted in any position.

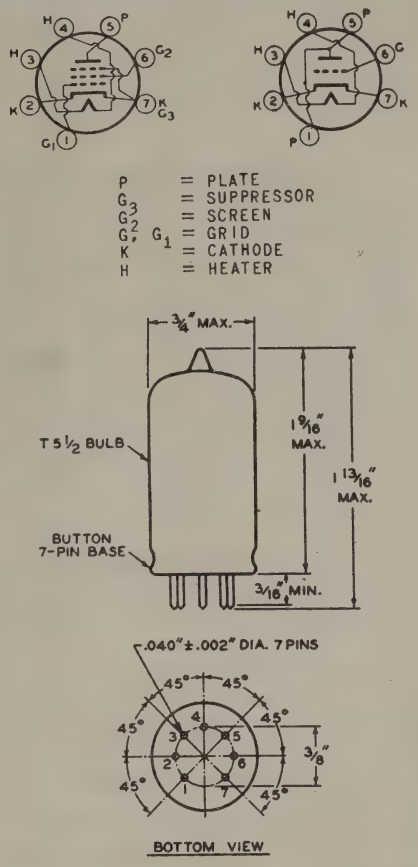
The heater voltage, under any condition of operation, should not vary more than 10 per cent. from the rated value of 6.3 volts.

The cathode of these types, when operated from a transformer, should preferably be connected to the heater circuit. In the case of D.C. operation of the heaters from a storage battery, the cathode circuit is tied in either directly or through bias resistors to the negative battery terminal. In circuits where the cathode is not directly connected to the heater, the potential difference between the heater and cathode should be kept as low as possible.

The screen voltage of the 9001 and 9003 may be obtained from a voltage divider across the B supply source or through a resistor in series with the high-voltage supply. The latter method, however, is not recommended if the high-voltage supply exceeds 250 volts.

Shielding and R.F. by-passing of each R.F. amplifier stage employing the 9001 and 9003 may be required in order to prevent inter-stage coupling and to provide the shortest possible circuit returns when the tubes are operated at the ultra-high frequencies. R.F. by-passing can be accomplished by the use of small condensers having short leads placed close to the tube terminals. It may also be advisable in some applications to supplement the action of the by-pass condensers by R.F. chokes close to the condensers in the return or supply leads for the grid, screen, plate, and heater. Each of the midget tubes is constructed with two cathode leads in order that the plate and screen R.F. circuits may be completed with a minimum of circuit inductance in common with the grid circuit. The grid circuit return may be connected to one cathode terminal and the plate and screen returns may be connected to the other cathode terminal.

Bottom View of Socket Connections



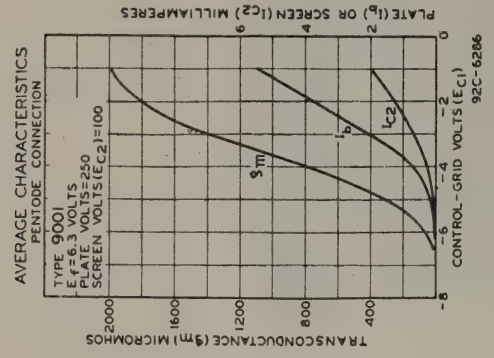
9001—DETECTOR AMPLIFIER PENTODE

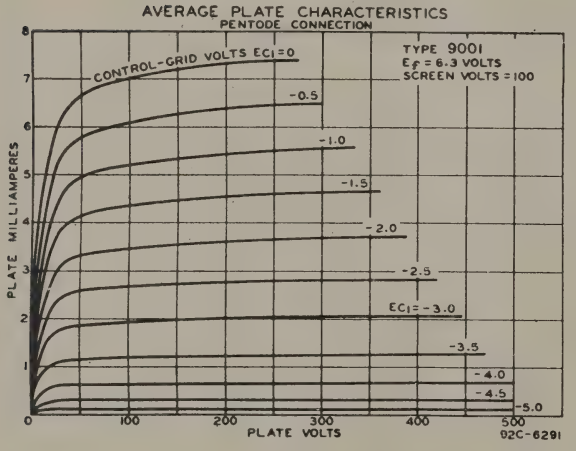
Heater voltage (A.C. or D.C.)	6.3 Volts.
Heater current	0.15 Amp.
Direct Interelectrode capacitances:	
Grid to plate	0.01 max. μμf.
Input	3.6 μμf.
Output	3.0 μμf.
Maximum overall length	1 13/16 in.
Maximum seated height	1 9/16 in.
Maximum diameter	3/4 in.
Bulb	T-5-1/2
Base	Button 7-pin

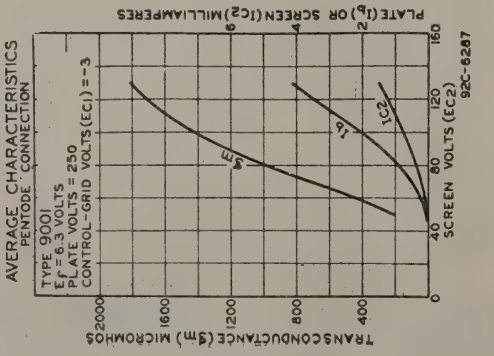
MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

Plate voltage	250 max. volts
Screen voltage	100 max. volts
Grid voltage	—3 min. volts

Typical Operation as Class A1 Amplifier:			
Plate voltage	90	250	volts
Screen voltage	90	100	volts
Grid voltage	—3	—3	volts
Plate resistance (approx.)	1.0	greater than 1	meg.
Transconductance	1100	1400	μmhos
Plate current	1.2	2.0	Ma.
Screen current	0.5	0.7	Ma.
Typical operation as mixer in superheterodyne circuits:			
Plate voltage	100	250	volts
Screen voltage	100	100	volts





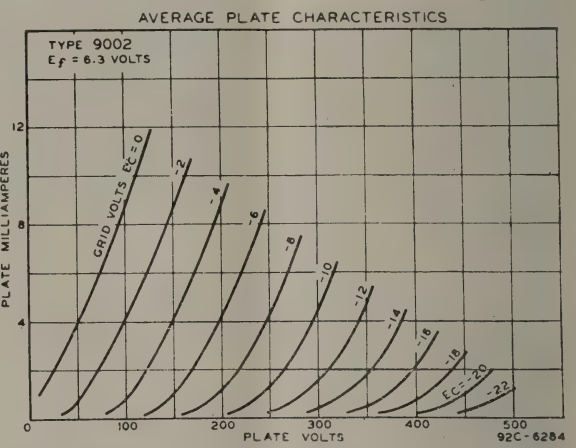


Grid volatge (approx.)*	—5	—5	volts
Conversion transconductance (approx.)		550	μmhos

*The grid bias shown is minimum for an oscillator peak voltage of 4 volts. These values are optimum.

9002—DETECTOR AMPLIFIER TRIODE

Heater voltage (A.C. or D.C.)	6.3 volts
Heater current	0.15 Amp.
Direct interelectrode capacitances:	
Grid to Plate	1.4 μμf.
Grid to cathode	1.2 μμf.
Plate to cathode	1.1 μμf.
Maximum overall length	1 13/16 in.
Maximum seated height	1 9/16 in.
Maximum diameter	¾ in.
Bulb	T-5-1/2
Base	Button 7-pin



MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

Plate voltage			250 max	Volts
Typical operation as Class A1 amplifier:				
Plate voltage	90	180	250	Volts
Grid voltage	—2.5	—5	—7	Volts
Amplification factor	25	25	25	
Plate resistance	14700	12500	11400	Ohms
Transconductance	1700	2000	2200	μmhos
Plate current	2.5	4.5	6.3	Ma.

9003—SUPER-CONTROL AMPLIFIER PENTODE

Heater Voltage (A.C. or D.C.)	6.3	Volts
Heater current	0.15	Amp.
Direct interelectrode capacitances:		
Grid to plate	0.01 max.	μμf.
Input	3.4	μμf.
Output	3.0	μμf.
Maximum overall length	1 13/16 in.	
Maximum seated height	1 9/16 in.	
Maximum diameter	¾ in.	
Bulb	T-5-1/2	
Base	Button 7-pin	

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

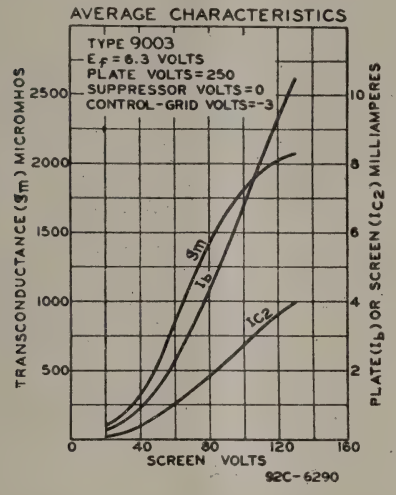
Plate voltage	250 max.	Volts.
Screen voltage	100 max.	Volts.
Grid voltage	—3 min.	Volts.
Typical operation as Class A1 amplifier:		
Plate voltage	250	Volts,

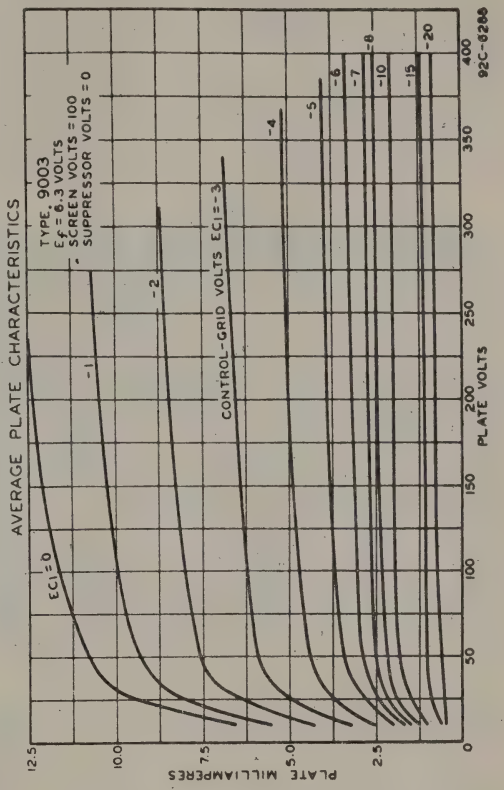
Screen voltage	100	Volts.
Grid voltage	—3	Volts.
Plate resistance (approx.)	0.7	Megohm.
Transconductance	1800	μmhos
Transconductance at —45	2	μmhos
Plate current	6.7	Ma.
Screen current	2.7	Ma.

Typical operation as mixer in superheterodyne circuits:

Plate voltage	100	250	Volts.
Screen voltage	100	100	Volts.
Grid voltage (approx.)**	—10	—10	Volts.
Conversion transconductance (approx.)		600	μmhos

**The grid bias shown is minimum for an oscillator peak voltage of 9 volts. These values are optimum.





New Zealand's Greatest Carrier

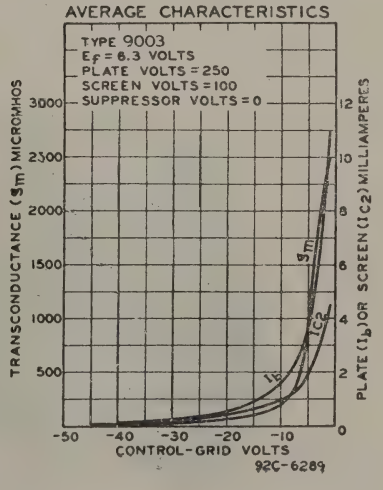
Railways Indispensable to National Economy

For only 16 per cent. of the estimated total cost of all forms of transport in New Zealand, the railways carry 46 per cent. of the freight traffic and a substantial portion of the passenger traffic.

National prosperity depends upon efficient, economical transportation, and, in order to keep down the cost of this service, the railways are modernizing, strengthening, and adding to their equipment as rapidly as the present world-wide conditions will permit. Last year, for example, several of the large number of new locomotives on order and 641 new wagons were placed in traffic, while more than 50 miles of track were relaid with heavier rail.

The tonnage which the railways are moving despite coal shortage and other difficulties common to industry just now, demonstrates the importance of railway transport in the economic structure of New Zealand and emphasizes its significance as the basis of our national transportation system.

The Railways Deliver the Goods



The PERFECT TEST TEAM

ELECTRONIC TESTMETER

A 56-range instrument combining the sensitivity of a delicate galvanometer with the robustness and ease of handling of an ordinary multi-range meter. Consists basically of a highly stable D.C. Valve Millivoltmeter, free from mains variations and presenting negligible load on circuit under test.

Switched to measure :—
D.C. Volts : 2.5mV to 10,000V.
D.C. Current : 25μA to 1 Amp.
A.C. Volts : .1V to 2,500V R.M.S. up to 2 Mc/s.
.1V to 250V R.M.S. up to 200 Mc/s.
A.C. Power Output : 5mW to 5 Watts.
Decibels : —10db to +20db.
Capacitance : .0001μF to 50μF.
Resistance : .2ohm to 10 Megohms.

Operates on 100-130v. and 200-260v., 50-60 c/s A.C. mains.

ELECTRONIC TEST UNIT

For measuring small values of A.C. voltage, inductance, capacity, and "Q" at radio frequencies. Although designed primarily for use with "AVO" instruments, it can be used with any suitable Signal Generator/Valve Voltmeter combination.

As a Wide Range Amplifier, it is capable of an amplification factor of 40±2—3db between 30c/s and 20Mc/s.

As a Capacity Meter, it covers measurements at radio frequency from .5pF. to 1000pF. in two distinctly calibrated ranges.

As an Inductance Meter, it gives direct measurements from .5μH. to 50mH. in six ranges.

As a "Q" Meter, it indicates R.F. coil and condenser losses at frequencies up to 20 Mc/s.

Operates on 100-130v. and 200-260v., 50-60 c/s A.C. mains.

WIDE RANGE SIGNAL GENERATOR

An instrument of wide range and accuracy for use with modern radio and television circuits.

Turret coil switching provides six frequency ranges covering 50 Kc/s. to 80 Mc/s.

Range 1.	50 Kc/s.—150 Kc/s.
" 2.	150 Kc/s.—500 Kc/s.
" 3.	500 Kc/s.—1.5 Mc/s.
" 4.	1.5 Mc/s.—5.5 Mc/s.
" 5.	5.5 Mc/s.—20 Mc/s.
" 6.	20 Mc/s.—80 Mc/s.

Accuracy to within 1% of scale marking. Gives sensibly constant signal of good wave-form, modulated or unmodulated, over entire range. Minimum signal less than 1μV at 20 Mc/s. and less than 3μV between 20 and 80 Mc/s. Gives calibrated output from 1μV to 50mV.

Operates on 100-130v. and 200-260v., 50-60 c/s A.C. mains.

Battery-operated model also available.

The illustration depicts a set of modern "AVO" testgear being used to measure the "Q" of the secondary winding of the second I.F. transformer on a chassis of unknown characteristics—just one of many tests which can be performed by this combination of instruments.

A signal of predetermined frequency from the "AVO" Wide Range Signal Generator is being fed into the Electronic Test Unit, where it is amplified and fed to the secondary winding of the transformer. The Electronic Testmeter is connected across the tuned circuit under test and, from the readings obtained and the controls of the Electronic Test Unit, the "Q" of the circuit can be determined.

The three instruments, shown as a team, cover a very wide field in measurement and form between them a complete set of laboratory testgear, ruggedly constructed to withstand hard usage.

For further information, write any branch of

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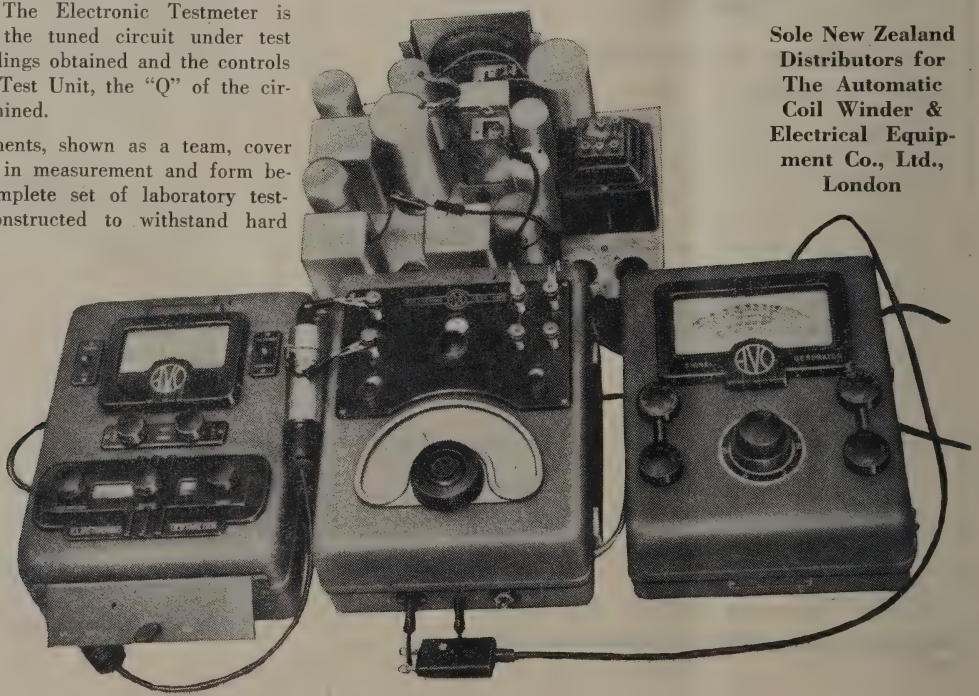


The Editor's Opinion

The E.M.I. Component Bridge

Modern radio and electronic servicing calls for a good deal more in the way of test equipment than the volt-ohm-milliammeter and test oscillator that have been the standby of servicemen for so long, and yet there is a distinct gap in the range of medium-priced measuring instruments, of reasonable accuracy. One item of equipment which the writer considers almost indispensable is a simple bridge that will give measurements of resistance and capacity to a sufficient standard of accuracy, and yet very few instruments of this class seem to be available. It is true that universal bridges in the high-priced class can be obtained, but for the sort of work under consideration, their accuracy is unnecessarily high, and the price is so great as to put them in the uneconomic class for by far the majority of workers. It was with some pleasure, therefore, that we received from Messrs. H.M.V. (N.Z.), Ltd., this advance sample of the E.M.I. component bridge. The intsrument, which is illustrated on this page, is neither excessively accurate nor too costly to put it within the means of the serviceman, while its accuracy is ample for all service purposes. Indeed its whole specification is such that it cannot fail to form an extremely useful adjunct to any service bench, or to any amateur laboratory. Here is an abridged specification, taken from the manufacturers' data:

TECHNICAL SPECIFICATION

Bridge Measurement Ranges

Resistance	*Capacity*	*Inductance*
10 ohms to 1000 ohms	10 $\mu\mu$f. to 1000 μf.	1 henry to 100
1000 ohms to 100k.	0.001 μf. to 0.1 μf.	henries.
100k. to 10 megohms.	0.1 μf. to 10 μf.	*Power Factor*
1 meg. to 100 meg.	10 μf. to 100 μf.	0.1 μf. to 10 μf.

Polarizing Voltages

For measuring electrolytic condensers, polarizing voltages may be obtained from he instrument itself so that the condensers may be tested under actual working conditions. The three voltages available are 5, 50, and 150 volts.

Leakage Test

An arrangement is provided whereby the meter which is normally used as the null indicator of the bridge, is used to indicate leakage. Test voltages of 200, 400, and 600 are available for use during this test, so that the majority of ordinary condensers may be examined for leakage.

Power Factor

The power factor can be measured of condensers within the range 0.1 μf. to 10 μf.

Accuracy and Discrimination

Resistance and Capacity Ranges: The error does not exceed 5 per cent., and discrimination is within this limit. Close-limit external standards can be used to increase this accuracy is desired.

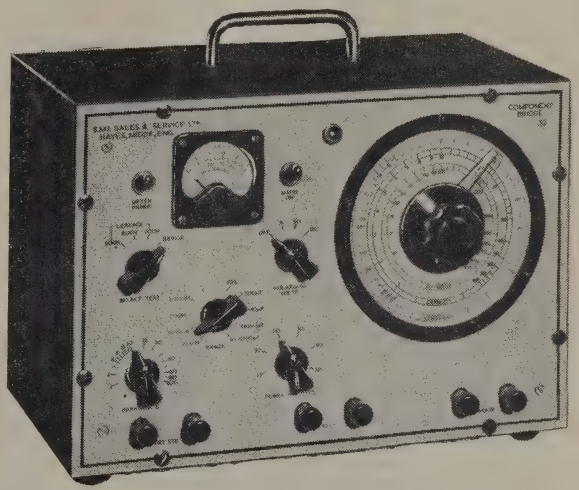
Power Factor Range: Error is less than $\pm$ 10 per cent.

Leakage Test: The error is approximately $\pm$ 5 per cent. At low levels, the meter reading is not better than this, while at high leakages, greater accuracy is unnecessary.

The order of accuracy indicated in the above paragraph is ample for the kind of work for which the bridge is intended, and indeed for the majority of design work, in which it is very seldom that components must have values that are known to better accuracy than this.

CIRCUIT DESCRIPTION

The instrument has two completely separate circuits, one of which is used for the bridge measurements, and the other for leakage tests. Only the meter and the power supply is common to the two circuit arrangements. The instrument is powered from the 50 c/sec. mains, and a special secondary winding on the power transformer provides the 50 cycle energizing voltages for the bridge. For all resistance ranges except the highest, the voltage applied to the bridge is 10v. R.M.S., and this voltage is also used for the 0.001–0.1 μf., and the 0.1–10 μf. capacity



ranges. For the highest resistance range and the lowest capacity range, the bridge is supplied with 60 volts, and for the 1–100 μf. capacity range, 6 volts is used.

The null indicator circuit consists of a double-diode-triode valve, of which the triode section is used to amplify the bridge output. The diodes are paralleled and used to rectify the output of the triode, and this rectified output operates the 0–500 amp. meter movement on which the null is indicated by adjusting the bridge for minimum deflection.

On the leakage test position, the circuit consists of a simple arrangement in which the condenser to be tested is placed in series with the test voltage and the meter. The two highest test voltages are obtained from a separate 400-volt winding on the power transformer, which is rectified by a small metal rectifier, smoothed, and applied to the positive test terminal. The meter is shunted by two reverse-connected metal rectifiers which give the meter a logarithmic law. This feature allows high leakage currents to be read without the necessity for switching the meter to a succession of ranges, and also acts as a protection for the movement in the case of condensers that are almost a short circuit. On the front panel is a switch which, when pressed, removes these rectifiers from circuit, and gives the meter its normal range of 0–500 amps. The switch is used when the leakage to be read is only small, and the meter is protected from subsequent overload by making the switch spring-loaded to the position which connects the rectifiers. When the bridge is switched back into use, the condenser con-

nected to the leakage tesct terminals is automatically discharged.

TEST OF ACCURACY

In order to test the accuracy of the instrument, another bridge was employed, whose ratio arm potentiometer is known to be accurately calibrated to within 0.5 per cent. The E.M.I. bridge was set to the "External Standard" position, and leads were taken from the appropriate terminals so that the ratio arms of the two bridges themselves formed a bridge. With this arrangement, it was possible to set the dial of the E.M.I. bridge to given readings, and by balancing the standard bridge, to read, to an accuracy of 0.5 per cent. the actual ratio provided by the bridge under test, at its nominal setting.

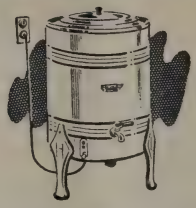
By this means, it was found that the calibration of the potentiometer of the E.H.I. bridge was everywhere accurate to within 1 per cent. This means, therefore, that if external standards are used with the bridge that are accurate to within 1 per cent., the overall measuring accuracy should be ± 2 per cent. Also, this proves that by switching the E.M.I. bridge to the "Ext." position, it would be possible to match pairs of resistors or condensers to an accuracy of 1 per cent. It was noted that the instruction book provided with the instrument does not claim any specific accuracy for the open bridge position, but the above tests indicate that the general claim for greater accuracy than 5 per cent. is well substantiated.

OPERATION

The bridge was found very simple and quick to operate, even in cases where the value of the component was not approximately known. When this is the case, it is only necessary to turn the range swtich rapidly and find which range gives the lowest reading on the meter,

(Concluded on page 48.)

HAYMANISE YOUR HOME



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TRADE WINDS

N.Z. Radio Traders Relax at Chateau Tongariro

About twenty-eight members and wives were present at the Annual Conference of the N.Z. Radio Traders' Federation which was held at the Chateau from 26th to 29th April, and in spite of a heavy business programme (or perhaps because of it) members were able to enjoy to the full the less serious attractions and amenities offered by the Chateau. In spite of a lack of heating, the social activities went off, as it were, with a bang, and this was in no small measure due to what might be described as a more sociable form of central heating, which had recently been instituted with the approval of the Licensing Commission! When *R. & E.* arrived, most of the Auckland contingent were already there, having travelled by train the day before. Among the earlier topics of conversation, "Dusty" Rhodes's excellent tenor voice was well to the fore, as it appears that this stalwart had lightened the rather tedious journey with some stirring renditions!

After dinner, the indoor bowls rink was given rather a thrashing, and we regret to report that in a match arranged between the Auckland and Wellington contingents, the Aucklanders carried the day. It was left to Dud Billing, however, to discover that the floor was responsible for some peculiar behaviour (of the bowls) when set down with a left-hand bias from the fireplace end, and this information, imparted to his own side only, of course, almost resulted in the tables being turned. Not the least proficient members of the Traders' Bowling Club were some of the ladies, who, though a trifle unconventional as regards stance, at times put the men to shame. It appears, too, that one of the Wanganui members knew more about the game than could be considered strictly fair in such amateur company, and in our opinion this gentlemen must have mis-spent at least some of his youth in acquiring proficiency at this abandoned game.

As usual, however, it was the billiard table that really gave a clue as to which members had squandered their early years in profitless pursuits. Of course, Harry Osborn is not properly speaking a radio man, so that his almost professional touch in no way reflected upon the antecedents of the radio trade as a whole. Peter Luxford, it was noted, seemed to give his most dashing performances round about the witching hour of midnight, but we have not yet quite worked out the significance of this observation.

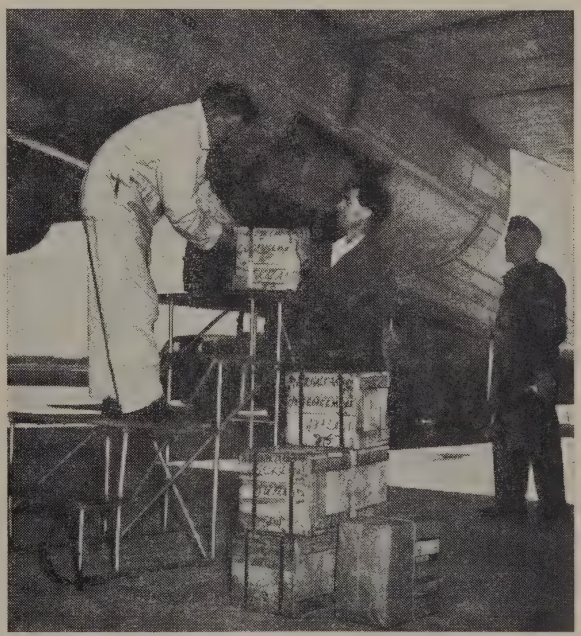
On the first evening, the executive went into a huddle as far away from the diversionary activities as possible, and while it was suspected that they were cooking up something for the morrow, and were therefore committing themselves to deliberation on more serious matters, it was noteworthy that they by no means eschewed several "rounds" that were set up for them by some indefatigable Auckland members, who, for the common good, saw to it that the waiters really earned their keep that night!

It appears that members of the radio fraternity, possibly through long contact with broadcast receivers, have yet to be recognized by the public at large for their flair as Masters of Ceremonies, vocal artists, impersonators, and entertainers extraordinary. Jack Hodge, for example, must have qualified as the New Zealand Bing Crosby, what with being Resident Comedian to the Conference, leader of sing-songs, and, in lighter moments, Golf Champion Presumptive. Under his leadership, it was impossible for a single member to hide his talent under the proverbial bushel, but we must also pay a tribute to Bill Murphy, whose "Loverly Bunch of Coconuts" was a sure-fire stop-gap at any time when M.C. Hodge's ideas momentarily flagged.

On the morning after the conclusion of the Conference proper, those who did not have to travel home immediately, made an attack on the mountain, and it was with some initial difficulty that *R. & E.* sorted out who was who underneath the almost impenetrable disguises of climbing boots and warm woollies in order to say good-bye to them. Unfortunately, we were not able to accompany the party, and so can only imagine the stirring feats that must have been performed by President Fairclough and his party. Unfortunately, space does not allow of as full a description of the doings outside the Conference room as we would like to give; we could comment, for example, on the difficulties inherent in travelling from the Chateau to Dunedin via Auckland, as encountered by Harry Osborn, not to mention the almost incredibly fast take-off of the taxi from the Chateau door, and such matters as the Cromwell dealer from a certain state in the Middle East.

In conclusion, we would like to express the thanks of all that attended the Conference to the Auckland delegates, who acted as hosts, and whose hospitality was very much appreciated.

ZINC BEING FLOWN TO NEW ZEALAND



Like many other firms, National Carbon Pty., Ltd., Wellington, manufacturers of "Eveready" batteries, feels the effects of the waterfront dispute.

The illustration below shows a Lancastrian at Auckland unloading part of eight tons of zinc flown from Sydney to enable the Wellington plant to continue the manufacture of dry batteries. Local Australian cost of zinc is £65 a ton, air freight costs £230 per ton.

Radio Sound and Service, Ltd., have opened a retail shop for radio and electrical goods at Courtenay Place, corner of Blair Street in Giles and Elliott's block. With the latest of shop fittings and appointments, simplicity of design and eye-appealing layout, an impression of ample space for demonstration and display is given.

* * *

Grover Electrical Co., Ltd., continuing to expand in the radio and electrical field, will be moving in July from their temporary premises in Palmerston North to a new building in Church Street, having 2,800 feet of floor space.

* * *

Ted Wood has been making an extensive tour of New Zealand, contacting Harbour Boards in connection with radiophone equipment.

* * *

Mr. D. L. Schultz, who recently gained a Rhodes Scholarship which will take him to Oxford University, was in 1949 awarded the National Electrical and Engineering Electronics Scholarship, and under it carried out post-graduate work at Canterbury College last year.

PUBLICATIONS RECEIVED

From the Radio Industry Council, London, England, Sections 1 and 2 of the following specifications:

Specification No. RIC/136: Capacitors, fixed, paper dielectric, tubular, metallized.

Specification No. RIC/141: Capacitors, variable air dielectric, tuning.

Specification No. RIC/214: Transformers, power, up to 2 K.V.A. rating.

Specification No. RIC/321: Plugs and Sockets (for frequencies up to 1 mc/sec.).

Specification No. RIC/322: Plugs and Sockets (for frequencies above 1 mc/sec.).

The latest additions to the series of Specifications of Components which the Radio Industry Council will publish and which is intended eventually to cover all components in general use in the radio and electronic industries.

These specifications have been produced by agreement between B.R.E.M.A., R.C.E.E.A., and R.E.C.M.F., whose individual contributions to the substance of the documents have been co-ordinated and edited by the Technical Specification Committee of R.I.C. and have been authorized for publication by the Technical Directive Board of R.I.C. on which the constituent associations of R.I.C. are represented.

Note these specfications can be seen at the offices of *Radio and Electronics,* and arrangements can be made for the supply of copies at reasonable cost.

* * *

The National Electrical Review, April, 1951 (Nat. Elect. and Eng. Co., Ltd.); B.I.C.S. Bulletin No. 2 (Nat. Elect. and Eng. Co., Ltd.); Electrical Communications, December, 1950 (Standard Telephones and Cables Ltd.); Philco World, Vol. 4, No. 1, Philco International Corp. (Russell Import Co., Ltd.); G.E.C. Journal, October, 1950, and June, 1951, G.E.C. Co., Ltd., England (G.E.C. N.Z., Ltd.); The Scanner, February, March, Decca Radar, Ltd. (Electronic Navigation Ltd.); Philpis Anniversary Bulletin, 1891-1951, Philips Electrical Industries of N.Z., Ltd.; Sylvania News, March, 1951, Sylvania Electrical Products, Inc. (G. A. Wooller and Co., Ltd.); "Mastery of Measurement," Marconi Instrument Ltd, (Amalgamated Wireless (Aust.) Ltd.); Coaxial Frequency Chart, Standard Telephones and Cables, Ltd.; Courtenay Station Log, Turnbull and Jones, Ltd.; Leaflet "Sphere" All-wave H.F. Signal Generator, Sphere Radio Co., Ltd.; Range of S.P. Leaflets on Courtenay, Turnbull and Jones, Ltd.; Quantity of Circuit Diagrams of 1937-47 Receivers, Radio (1936) Ltd.

LARGE V.H.F. RADIO CONTRACT AWARDED TO NEW ZEALAND FIRM

A contract for £30,600 has been let by the Government Stores Board on behalf of the Civil Aviation Branch of Air Department to Messrs. Collier and Beale, Ltd., Wellington, for the manufacture of a quantity of very high frequency radio receivers and transmitters. This equipment is to be used at all aerodromes and aeradio stations throughout the country and in the islands under New Zealand control.

The installation of this type of equipment is part of the Department's programme to change over all communications between civil aircraft and ground stations from the high frequency band to the very high frequency band.

The use of very high frequency communications for this purpose has many advantages over the lower frequencies, principal among which is the fact that communications will be practically interference-free, so that the clarity of reception will be considerbly improved. In the V.H.F. band, frequency channels have been set aside for use by civil aviation to allow for future expansion of services, whereas no further frequencies are available in the H.F. band and the H.F. channels at present in use are overloaded, resulting in considerable interference.

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18 S.W.G., 60 per cent. tin, 40 per cent. lead.

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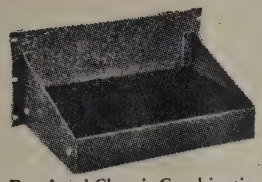

Panel and Chassis Combinations

CHASSIS AND PANEL COMBINATIONS

Chassis size	17 in. x 10 in. x 3 in.	37/6
Chassis only	17 in. x 10 in. x 3 in.	18/–
„ „	15 in. x 9 in. x 3 in.	16/–
„ „	12 in. x 8 in. x 2½ in.	14/–
„ „	9 in. x 7 in. x 2½ in.	10/6

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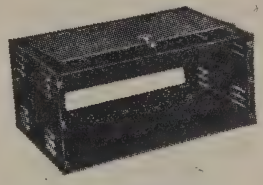
To take chassis	Round End	Square End
17 in. x 10 in. x 3 in.	£3 10 0	£3 4 6
15 in. x 9 in. x 3 in.	£3 5 0	£2 19 6
12 in. x 8 in. x 2½ in.	£2 15 0	£2 10 0
9 in. x 7 in. x 2½ in.	£2 5 0	£2 0 0

Postage Included.



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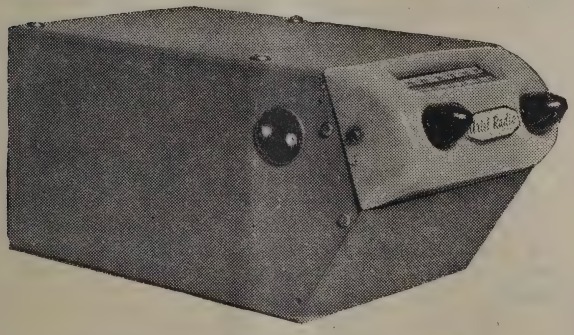
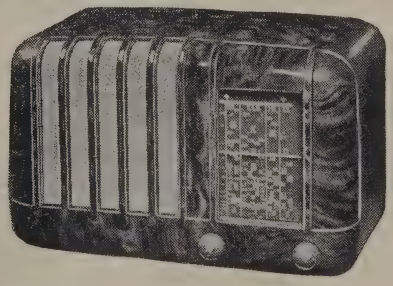


- 5 RIMLOCK VALVES AND RECTIFIER
- PHILIPS I.F.s
- 6-INCH SPEAKER

PRICE COMPLETE £16 10s.



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- 6-INCH SPEAKER
- MOULDED PLASTIC CABINET
- SLIDE RULE DIAL

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WEBB'S RADIOS LIMITED

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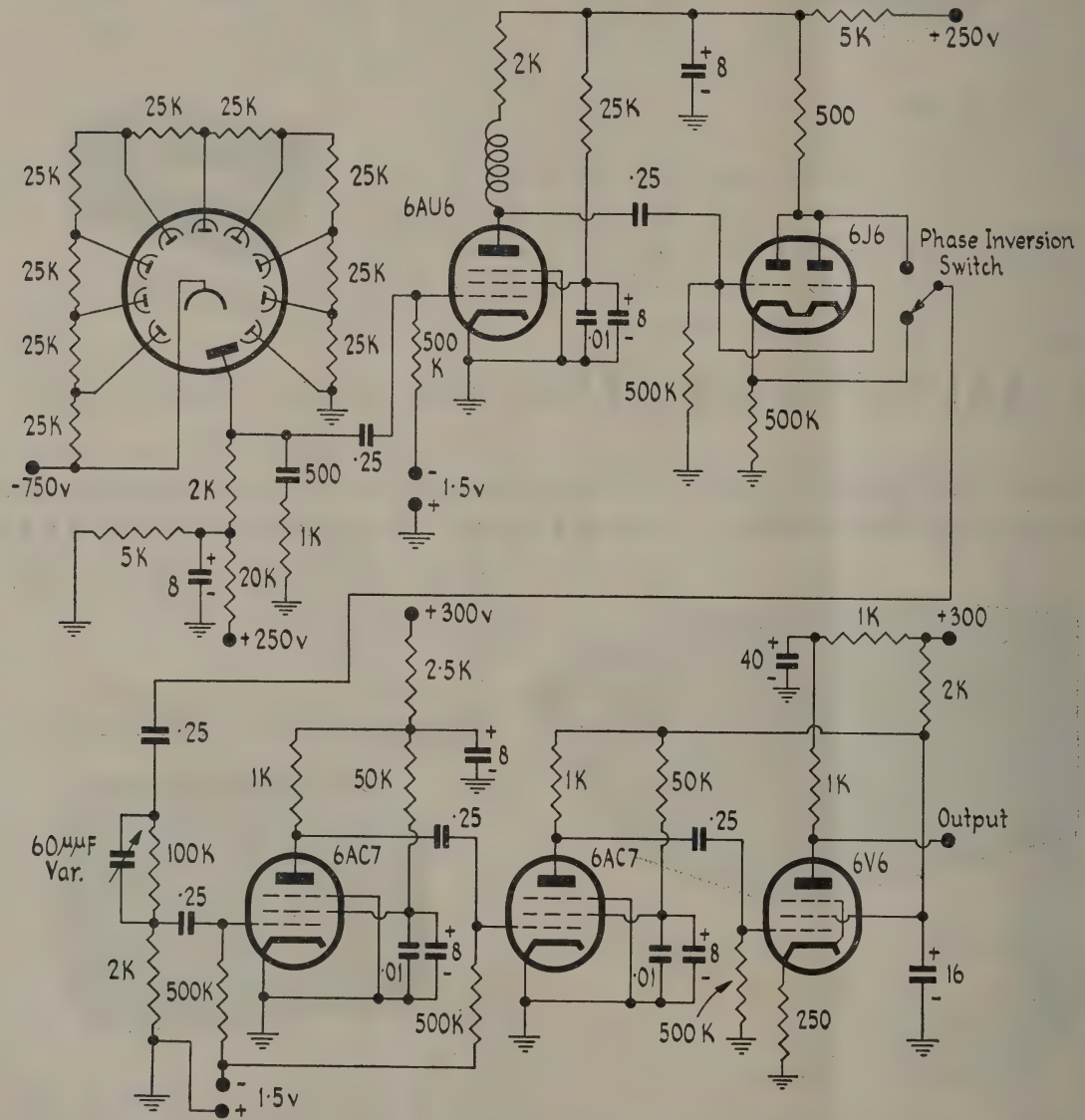
Amateur TV Project

(Continued from page 8.)

be only 500 ohms, or the same value as the plate resistor.

At the input of the first 6AC7 will be found the first main departure from standard practice. We have here a voltage divider made up of a 100k. resistor and a 2k. resistor, with the output to the grid of the tube taken from the junction. Thus, only about one-fiftieth of the voltage available from the 6J6 is applied to the next stage. As might be expected, there must be a very quencies would be equally attenuated, but as it is, the lower frequencies only are decreased in amplitude, while the very high frequencies are passed through with very little attenuation by the small condenser. The net result is a response that rises sharply from about 100 kc/sec., up to the highest frequency the remainder of the circuit will amplify.

(To be continued.)



good reason for doing a thing like this, and there is. The fact is that the network in the grid circuit of the first 6AC7 is a frequency compensating device, whose job it is to cause a greta increase in the amplification at the high video frequencies, compared with that at low. If the 60 μμf. variable condenser were omitted, all fre-

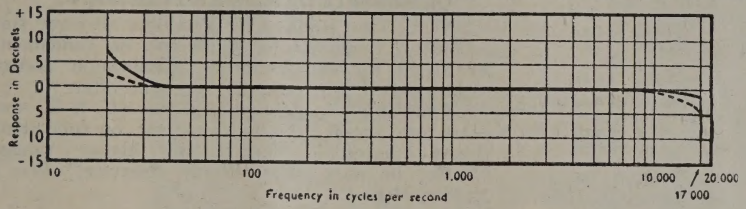
Remember that copies of all technical photographs in this journal are obtainable from "Radio and Electronics."

P. C. Collier Comments on Civil- Aviation V.H.F. Contract

In an interview, Mr. P. C. Collier said that, while he was naturally gratified that his firm had succeeded in securing the contract, he felt that the fact that it had been awarded to a New Zealand firm, in open competition with the largest overseas concerns, was a compliment to the radio industry as a whole, showing as it does that those responsible for the equipment have full confidence that this important work will be carried out just as satisfactorily by one of our own manufacturers as it could be by much larger and longer established firms from overseas.

BRIERLEY PICK-UPS

The JB/P/R Pick-up has been designed with the sole object of obtaining as realistic reproduction from gramophone records as possible with negligible wear of records. The real test is a listening test and not specification data, and, provided the recording and the rest of the equipment are of a sufficiently high standard, the results obtained are such that it can be difficult to realize that one is not listening to an original performance.



Dotted Line refers to Ribbon Pick-up Full Line refers to Armature Pick-up
Response Curves include Coupling Transformers
Correction has been made for low-frequency Attenuation in Test Record

Specification of Brierley Ribbon

Point: 80 times longer wearing than sapphire, ground and polished to an accuracy of 0.00002 in.
Total Mass of Moving Parts: 17 milligrams.
Effective Mass at the Point of Moving Parts: 4 to 5 milligrams.
Downward Pressure on Record: one-eight of an ounce.
Magnet Alloy: Alcomax.
Low-frequency Resonance: 5 c/s. (approximate).
Output Voltage: 0.0075 to 0.01v. R.M.S. (measured across secondary of Coupling Transformer with ½ megohm load).
No measurable upper resonance.
Vertical compliance.

Provision is made for vertical motion of the point to minimize so far as possible defects due to the "pinch" effect. The Pick-up is quite robust, and there is no possibility of damage occurring from normal use; accidental dropping on to the record surface will not cause any damage.

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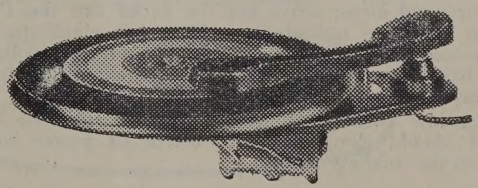
RECORD PLAYER VALUE

COLLARO has built a reputation for reliable gramophone units in which quality is of paramount importance. Price has, nevertheless, always been competitive.

The new COLLARO single players are fitted with powerful induction type Rim Drive AC MOTOR and are available with a choice of pick-ups—Magnetic, Crystal, High Fidelity.

Collaro Changers are at present in short supply, but supplies are expected shortly.



COLLARO, makers of fine-quality Gramophone Components, including Automatic Record Changers, Gramophone Units, Portable Electric Gramophones, Induction Motors, and Pick-ups.

The COLLARO
A.C. 514 Record Player

Sole New Zealand Distributors:

RUSSELL IMPORT CO., LTD. 20 BOND STREET WELLINGTON

Abstract Service

(Continued from page 9.)

Television and sound by wire—a brief description is given of a combined broadcast distribution system designed for North America.

—*Wireless World* (Eng.), April, 1951, p. 126.

High definition television. A new system is being considered with bandwidth compression. A normal video band may be divided into two approximately equal portions and using the idea of frequency interlace when transmitting the super high information. An outline of the system has been transmitted to the Federal Communications Commission.

—*Ibid*, p. 156.

Methods of servicing the intersync circuits—these separate the vertical from the horizontal sync pulses and are very critical and likely to be very troublesome.

—*Radio and Television News* (U.S.A.), March, 1951, p. 64.

A carrier current transmitter. Complete construction details on a practical unit which may be operated by the layman without licence.

—*Ibid*, April, 1951, p. 39.

MISCELLANEOUS

Radio-electronics plays a vital role in all naval operations and an outline is given of the lines on which the work is progressing.

—*Ibid*, p. 31.

In the byways of the electronic art one of the most intriguing applications of R.F. energy is to excite a discharge in a gaseous tube without electrodes. Details are given of a quartz probe which can be used for this purpose with an interesting field for experimenting.

—*Radio and Television News* (U.S.A.), March, 1951, p. 36.

A study of direct frequency modulation of quartz crystal resonators. It would seem that any attempt to produce frequency modulation from a crystal would be doomed to failure but a system has been developed which employs a new technique and ensures that the carrier frequency is at all times crystal controlled, the only variation in frequency being due to the desired modulation.

—*Wireless World* (Eng.), April, 1951, p. S. 15.

Radio Here and There

(Continued from page 16.)

The number of valves used is less than 40—about half the number required in earlier types of this equipment. This reduction has ben mainly achieved by using a new klystron of such stability that automatic frequency control is no longer required and by the adoption of a synchronous motor drive for the aerial and the P.P.I. (Plan Position Indicator) coils which eliminates the servo-mechanism formerly used. The working voltages, too, have been reduced and the insulation safety factor increased.

The low consumption of this equipment (one kilowatt) should eliminate any problem of power supply even in the smallest ship.

Philips Experimenter

(Continued from page 25.)

be just lower than makes the valve draw grid current. It is this maximum plate current that is used in the formula for the output voltage, because this is the current actually flowing when it is interrupted. At (b) can be seen the plate current waveform, from which it is clear that plate current flows only during the positive peaks of the input wave, and is then suddenly cut off in the required manner. The datted line on Fig. 2 (b) shows the *average* plate current, which is much lower than the peak plate current, with the result that the efficiency of the circuit is high. In a practical case, where the peak current is 120 ma., the average current is no more than 15 ma., which represents a very light drain on the power supply, which is only 300 volts.

The Editor's Opinion

(Continued from page 43.)

before any attempt is made at obtaining an accurate balance. This indicates at once which range the component falls in, whereupon the dial can be adjusted for balance, and the exact reading found in a matter of only a few seconds.

Summing up, the E.M.I. bridge is a well-made instrument that is easy to use, covers a wide range of measurements, has an actual accuracy well within the claims made for it by the makers, and above all is reasonable in price. Messrs. His Master's Voice (N.Z.), Ltd., will welcome inquiries from those interested in obtaining one of these instruments, and wish to advise that supply, at the moment, is to indent only.

★

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FOR SALE: One Radio City Products all-wave signal generator, range 0.1 to 30 mc/sec. on fundamental, 30 to 60 mc/sec. harmonic. Calibration accuracy better than 1 per cent. £35 or near offer.

One simple modulated oscillator (C. & B.—many years ago!) range 0.1 to 1.5 mc/sec. on fundamental (liberal harmonic supply for higher ranges!) £7 10s. or near offer.—Reply "Service," Box 93, Napier, H.B.

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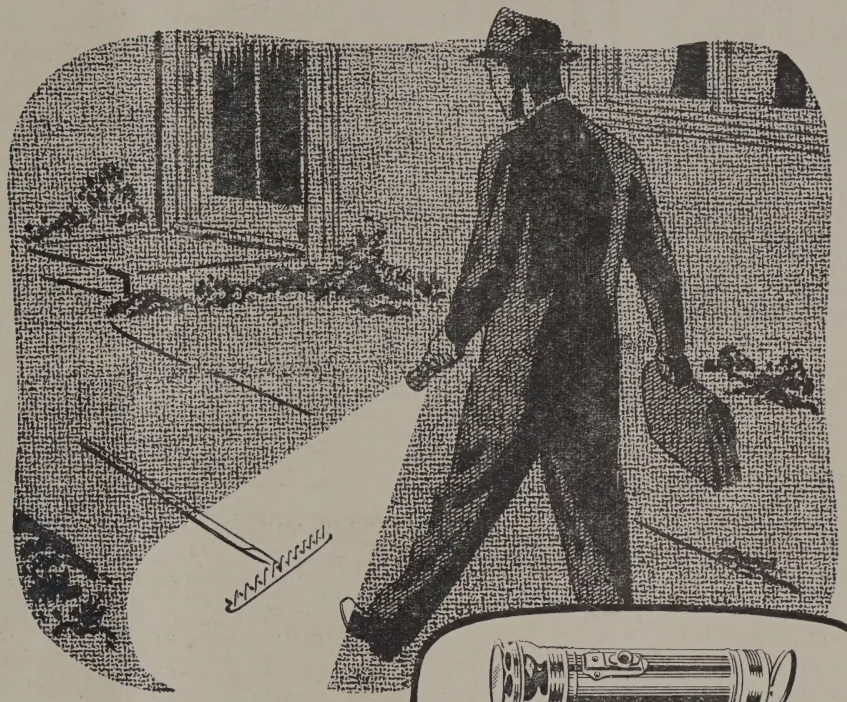
FOR SALE.—Palec, VCT Valve Tester Multimeter; also ZC1 MKI Transceiver 230v operation. Reply, care this paper.

Up the Garden Path



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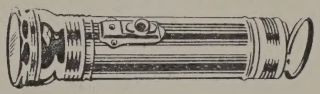

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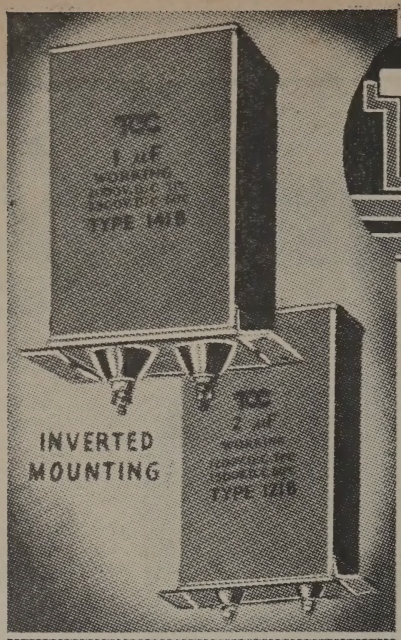
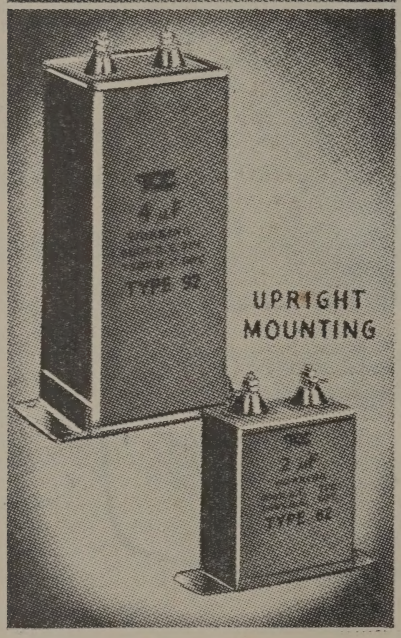




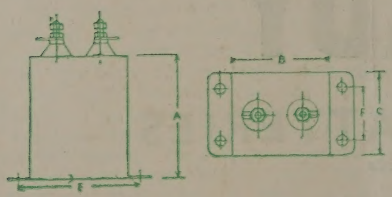
TROPICAL PAPER *Capacitors*

IN RECTANGULAR METAL CANS

TYPE	CAPACITANCE uF	DIMENSIONS IN INCHES A	B	C	E	F
TYPE 62	+0.25	2 3/8	1 3/4	3/4	2 1/8	—
350v. D.C. working	+0.5	2 3/8	1 3/4	3/4	2 1/8	—
(at 60 deg. C.)	+1.0	2 3/8	1 3/4	3/4	2 1/8	—
	+2.0	2 3/8	1 3/4	1	2 1/8	—
	+4.0	2 3/8	1 3/4	1 3/4	2 1/8	—
	8.0	4.11/16	1 5/8	2 3/8	2	1 7/8
TYPE 82	+0.25	2	2	3/4	2 3/8	—
500v. D.C. working	+0.5	2 3/8	2	3/4	2 3/8	—
(at 60 deg. C.)	+1.0	2 3/8	2	3/4	2 3/8	—
	2.0	2 3/8	2 1/8	1 1/4	2 1/2	—
	4.0	2.9/16	2 1/8	2 3/8	2 1/2	1 3/8
	8.0	4.11/16	1 5/8	3 1/8	2	2 3/8
TYPE 92	+0.25	2 3/8	2	3/4	2 3/4	—
750v. D.C. working	+0.5	2 3/8	2	3/4	2 3/8	—
(at 60 deg C.)	+1.0	2 3/8	2	1	2 3/8	—
	2.0	2.9/16	2 1/8	2 1/8	2 1/2	1 3/8
	4.0	4.11/16	2 1/8	2 1/8	2 1/2	1 3/8
	8.0	4.11/16	2 1/8	4 1/8	2 1/2	3 3/8
TYPE 111	+0.25	2 3/8	2	3/4	2 1/2	—
1,000v. D.C. working	+0.5	2 3/8	2	3/4	2 1/2	—
(at 60 deg. C.)	1.0	2.9/16	2 1/8	1 3/8	2 1/2	—
	2.0	4.15/16	2 1/8	1 3/8	2 1/2	—
	4.0	4.15/16	4 1/8	1 3/8	4 1/2	—
	8.0	4.15/16	4 1/8	2 3/8	4 1/2	1 3/8
TYPE 121B	+0.1	2 3/8	2	3/4	2 1/2	—
1,500v. D.C. working	0.5	2.9/16	2 5/8	1 3/8	3	—
(at 60 deg. C.)	1.0	4.15/16	2 1/4	1 1/8	2 5/8	—
	2.0	4.15/16	3 1/8	1 3/8	3 1/2	—
	4.0	4.15/16	3 1/8	2 3/8	3 1/2	1 7/8
	8.0	4.15/16	5 1/8	3 1/8	5 1/2	2 3/8
TYPE 131	0.1	2.9/16	2 1/4	1 1/4	2 5/8	—
2,000v. D.C. working	0.5	4.15/16	2 1/4	1 1/8	2 5/8	—
(at 60 deg. C.)	1.0	4.15/16	2 5/8	1 5/8	3	—
	2.0	4.15/16	2 5/8	2 1/8	3	1 7/8
	4.0	4.15/16	4 1/8	2 3/8	5 1/4	1 7/8
	8.0	4.15/16	4 1/8	5 3/8	5 1/4	4 3/8

NOTE: If inverted mounting (through chassis) style required, add suffix "IM" when ordering.

+Denotes plain soldered seams (others rolled seams).



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